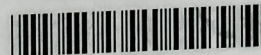


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ENVIRONMENTAL STATUS OF THE LAKE MICHIGAN REGION

VOLUME 15. MAMMALS OF THE
LAKE MICHIGAN DRAINAGE BASIN

CHARLES A. LONG

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ENVIRONMENTAL STATUS OF
THE LAKE MICHIGAN REGION

Volume 15.
Mammals of the Lake Michigan Drainage Basin

by

Charles A. Long*

Consultant to the
Environmental Statement Project

May 1974

PREFACE

Assessments of the environmental impacts of individual nuclear power plants sited on the shores of Lake Michigan have led to increased recognition of the need for regional considerations of the environmental impacts of various human activities, and on the need for a compendium of information on the environmental status of the region for use in assessing such impacts. In response to these needs, a report series describing the status of Lake Michigan and its watershed is in preparation. The series is entitled, "Environmental Status of the Lake Michigan Region"; this report is a part of that series.

The report series attempts to provide a reasonably comprehensive descriptive review and analysis of natural features and characteristics, as well as past, present, and proposed natural processes and human activities that influence the environmental conditions of Lake Michigan, its watershed, and certain adjacent metropolitan areas. It also is intended that this series will constitute a regional reference document useful both to scientific investigators and to other persons involved in environmental protection, resource planning, and management. In these regards, the "Environmental Status of the Lake Michigan Region" is intended in part to serve as an adjunct to reports of broader scope, such as the Great Lakes Basin Commission's Framework Study.

Other Volumes Published to Date in this Series

Vol. 7. *Earthquake History and Measurement with Application to the Lake Michigan Drainage Basin.* Richard B. Keener. NTIS-\$4.00. 19 pp.

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MAMMALS OF THE LAKE MICHIGAN DRAINAGE BASIN

by

Charles A. Long

ABSTRACT

The report is essentially a catalog of the wild mammals that inhabit the land in the drainage basin of Lake Michigan. For each species identified, data are presented on its aesthetic attributes, value, status, and distribution. The report concludes with a short discourse on the habitat preference, home range, and zoogeography of Recent mammals.

INTRODUCTION

The author undertook to prepare a report of the mammals in the Lake Michigan drainage basin in accordance with a contract dated March 22, 1973, with the Argonne National Laboratory.

This faunal account maps and documents the distribution of the mammals to help planning to minimize the disruption of the natural environment by the siting of nuclear plants and other developments. To this end, statements concerning the known economic values of wild animals and their aesthetic attributes are given.

New information is included from many previously unreported specimens from Wisconsin, upper Michigan, and northern Illinois housed in the Museum of Natural History at Stevens Point. The compilation of literature relies chiefly on the works of Burt (1948), Jackson (1961), Long (1970), Lyon (1936) and Cory (1912), whose records from Cook and Lake counties are chiefly those in Kennicott's (1858) publication. A brief analysis of zoogeographical information is presented. Readers interested in ecological studies on particular faunas and problems should consult Burt (1940), Pruitt (1953, 1959), Manville (1949), Allen (1938), Dice (1952) and Getz (1959, 1961a, 1961b). Papers by Long (1973) on reproduction in *Peromyscus leucopus* and De Vos (1964) on shifts of geographic range in the Great Lakes region may be of interest. Jackson's (1961) book listing Wisconsin mammals contains a great deal more than Wisconsin information, compiling natural history data with a bibliography complete until 1961, on all mammals in North America that occur in Wisconsin, including every species treated in this account. However, little ecological work has been carried out on small mammals of Wisconsin. On the following maps black symbols represent localities from which specimens were obtained and examined. Open symbols pertain to other records.

DESCRIPTION OF THE STUDY REGION

The Lake Michigan watershed is a large basin draining the southern valleys of the eastern part of the Upper Peninsula of Michigan, the valleys east of the Mississippi drainage in Wisconsin and the Chicago area of Illinois, a small part of northwestern Indiana, and the western valleys of lower Michigan (Fig. 1). Lake Michigan drains through the Straits of Mackinac at the north end.

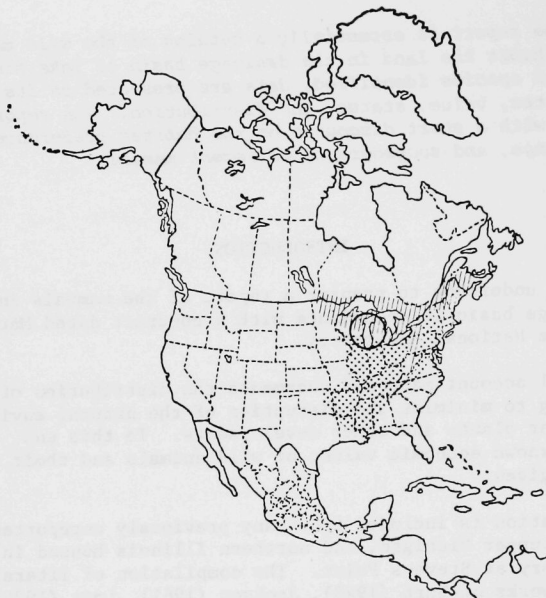


Fig. 1. Location of Lake Michigan Drainage Basin in the United States. Lined area is northern hardwoods-conifer ecotone. Stripped area deciduous woodland biome.

The watershed is ecologically diverse in varied terrestrial communities. In brief, the region can be categorized as conifer-hardwoods in the north (maple, balsam, white birch, white pine), deciduous forest in the south (oak, hickory), some prairie (grassland) in the south, and areas greatly altered by man. In the last-mentioned habitats, which steadily have encroached northward upon natural environments, there are urban areas and some lands showing former use in lumbering and agriculture (old field, brushy areas) (e.g. Curtis, 1959; Dice, 1938; Hooper, 1942).

The vast ecotonal areas are complex and extensive. Originally, the northern parts were forested with mixed conifers and hardwoods and the southern parts had a few prairies and extensive deciduous forests (Fig. 1). A narrow

ecotonal strip, often called a tension zone, extends across Wisconsin and a similar zone is found across the Lower Peninsula of Michigan (Dice, 1938).

There are many prominent, but less spectacular, geomorphic features in the watershed aside from the lake itself. In Wisconsin time, a huge glacier lay in the lake basin and sprawled westward across the valley of the Wolf River. Glaciers covered the watershed in the north and exerted a boreal influence along the terminal moraines and glacier-fed streams. Subsequent warming in post-Wisconsin time has uncovered the northern regions.

Annual rainfall is about 30 inches, and the depth of snow is much greater in the north. The growing season varies from about 100 days in the north to 170 in the south. Generally, the climate is more severe in the northern latitudes, but the lake moderates the climate along its shores. The abundant snowfall in the north helps the small mammals in winter (Long, 1973), although it is adverse to some species such as deer.

MAMMALS OF THE REGION

The following is a catalog of the mammals of the Lake Michigan watershed.

ORDER MARSUPIALIA--MARSUPIALS

DIDELPHIDAE - OPOSSUMS

Didelphis marsupialis Kerr. OPOSSUM. Also called 'possum.

Didelphis marsupialis virginiana Kerr.

Aesthetic attributes: Shaggy, gray fur; the only marsupial in the United States. The species is exceptionally primitive, having hardly changed since its ancestors appeared in late Cretaceous time. The opossum feigns death during danger.

Value: Fur bearer; scavenges carrion and feeds on injurious insects and mice as well as fruits; a meat animal often hunted by hounds in southern states. The opossum occasionally raids a chicken yard and sometimes eats eggs of song birds.

Status: Expanding geographic range northward (Long and Copes, 1968); entered the Lake Michigan region about 1900.

Distribution: Not yet found in some northern counties, but of general occurrence in southern ones (Fig. 2).

Specimens examined: Wisconsin: Kewaunee Co., Pierce Tws. (1); Manitowoc Co., Manitowoc (2); Washington Co., no locality (1); Waukesha Co., 2 mi. E Waukesha (1); Waupaca Co., Waupaca (10); and Winnebago Co., Hwy 110, S. Winchester (1). *Other records:* Wisconsin: Numerous counties (Jackson, 1961). Florence and Forest Counties (McCabe, 1972). Michigan: Ottawa, Ionia, Clinton, Allegan, Caton, Ingham, Kalamazoo, Calhoun, Jackson, Berrien, Cass, and Hillsdale counties (Burt, 1948:83). Northern Iron Co., and Sect. 28, Tws. 45 N, R 10 W (no specimen) (Ozoga and Gaertner, 1963). Illinois: Cook County (Cory, 1912:53); Lake County (Necker and Hatfield, 1941). Indiana: Six northern counties (Lyon, 1936).

Remarks: Anderson (1972), basing his opinion on unpublished findings by Gardner, lists *Didelphis virginiana* Kerr as a valid species.

ORDER INSECTIVORA--INSECTIVORES

TALPIDAE - MOLES

Scalopus aquaticus Linnaeus. PRAIRIE MOLE. Also called eastern mole and garden mole.

Scalopus aquaticus machrinus (Rafinesque).

Aesthetic attributes: Beautiful fur; remarkable fossorial adaptations.

Value: Eats enormous quantities of injurious grubs and other invertebrates in the soil. Occasionally eats garden seeds. Subsurface tunnels cause much harm to lawns, golf courses, and other sodded areas. Moles contribute to soil formation, but prey on worms which are excellent builders of top soil.

Status: Not rare in southern counties. Probably man is increasing areas of available habitat for moles by converting forests to lawns and fields.

Distribution: Prefers well-drained soils of prairies and lawns. Not yet known from some extreme northern counties on Lower Peninsula of Michigan, or most northern counties of Wisconsin and all of upper Michigan. Not known from any islands (Fig. 3).

Specimens examined: None. *Other records:* Wisconsin: Racine [questionable record] (Lapham, 1953:338). Michigan: Numerous counties along the east shore of Lake Michigan (Burt, 1948:86). Illinois: Chicago (Cory, 1912). Indiana: Six northern counties (Lyon, 1936).

Condylura cristata (Linnaeus). STAR-NOSED MOLE.

Condylura cristata cristata (Linnaeus).

Aesthetic attributes: Beautiful pelage; remarkable fossorial adaptations and twenty-two tentacles on the snout, tactile in nature.

Value: Fur has no economic value at present; habitat preference (wet soils of swamps and forests) precludes digging in lawns; aids in control of many species of insects, particularly larvae; also feeds on other invertebrates, particularly aquatic worms and some earthworms.

Status: Not rare in northern counties.

Distribution: Prefers swamps and mesic forest; is occasionally seen swimming even under ice (Fig. 4).

Specimens examined: Wisconsin: Forest Co., Newald (1) Mil. Mus.; Porgage Co., Heig's farm near Polonia (1); Marinette Co., Marinette (1), and Beaver Creek, 1 mi. E Beaver (1); Manitowoc Co., Branch River Country Club, Branch (1). *Other records:* Wisconsin: Numerous northern counties, one questionable record - Milwaukee (Jackson, 1961:73). Florence Co., Sea Lion Lake (McCabe, 1972). Michigan: Numerous counties along east shore of Lake Michigan, and on Upper Peninsula (Burt, 1948:89). Indiana: Noble Co. (Lyon, 1936).

Fig. 4. Distribution of *Condylura cristata*.

SORICIDAE - SHREWS

Sorex cinereus Kerr. MASKED SHREW. Also called cinereous shrew, long-tailed shrew.

Sorex cinereus cinereus Kerr.

Aesthetic value: Richly brown with delicate feet; remarkably voracious behavior, high metabolism, and unusually small size.

Value: Very beneficial to man as an important biological control on injurious insects (Buckner, 1955).

Status: Very abundant especially in marshes, but becoming uncommon in settlements.

Distribution: Occurs mainly in wet, boreal habitats, but is occasionally taken in dry woods or prairie throughout watershed (Fig. 5).

Remarks: Burt (1943) and Jackson (1961) assign southern populations to *Sorex cinereus lesueurii*. In Michigan there seems to be a wide area between the known ranges of *S. c. cinereus* and *S. c. lesueurii*. In Wisconsin, I ascertain no geographic differences in the masked shrews, and the distribution is generally continuous.

Specimens examined: Wisconsin: Florence Co., 1 mi. S Chipmunk Rapids, Lost Lake (1); Marinette Co., Kresl's Resort on Lake Noquebay (1), 8 mi. N Marinette near Menominee River (1), 9 mi. NW Crivitz on County A (3); Manitowoc Co., 15 mi. NW Manitowoc (2), 3 mi. S Manitowoc (1); Oconto Co., Mountain (1) Racine Co., Hwy 38, 5 mi. W Racine (1) [possibly referable to *S. c. lesueurii*]. Michigan: Delta Co., 15 mi. E Escanaba on Stonington Peninsula (1). **Other records:** Wisconsin: Numerous counties (Jackson, 1961:32). Michigan: Numerous counties on Upper Peninsula, and Emmet, Charlevoix, and Roscommon counties in northern parts of the Lower Peninsula (Burt, 1948:93). Beaver Island (as *S. c. cinereus*?) (Ozoga and Phillips, 1964). South Manitou Island (as *S. cinereus*) (Scharf, 1973:17).

Sorex cinereus lesueurii (Duvernoy).

Aesthetic attributes, Values and Status as in *Sorex cinereus cinereus*.

Distribution: Northern Illinois and Indiana, and southern counties of lower Michigan (Fig. 5).

Specimens examined: None. **Other records:** Michigan: Clinton, Allegan, Ingham, Kalamazoo, and Jackson counties (Burt, 1948:93). Illinois: Lake Co., Fox Lake (Cory, 1912:414); Chicago (Necker and Hatfield, 1941:42). Indiana: Porter, St. Joseph, and Elkhart counties (Lyon, 1936).

Fig. 5. Distribution of *Sorex cinereus*. *S. c. cinereus* (circles) and *S. c. leseurii* (triangles).

Sorex palustris Richardson. WATER SHREW.

Sorex palustris hydrobadistes Jackson.

Aesthetic attributes: Pelage of black, washed with silver; occasionally seen swimming or running over the water surface (using surface tension). Remarkable adaptations of a tiny, aquatic mammal, which are unusual contrasted with those of a large aquatic mammal. For example, the fringe of hairs on the hind foot are analogous to the webbing in the hind foot of the beaver. Water shrews provide an interesting example of a mammal with a very narrow ecological niche, for water shrews never stray more than a few feet from standing water where they feed on minnows, aquatic insects and other invertebrates.

Value: Preys on injurious insects. Water shrews, of course, cause no appreciable harm to game fishes.

Status: Exceptionally rare, and local in distribution, therefore listed as threatened.

Distribution: Found only along the banks of brooks, the shores of lakes, and in marshes. Occurs only in northern counties and is unknown on islands (Fig. 6).

Remarks: The piscivorous habits of this rare, local mammal make it susceptible to extirpation by fish poisons and pollutants which exterminate fishes in marshes and brooks.

Specimens examined: Wisconsin: Marinette Co., Beaver Creek, Beaver (1), and Grand Rapids Dam, Menominee River (1). **Other records:** Wisconsin: Marinette Co. (Jackson, 1961:39). Michigan: Upper Peninsula: Marquette and Menominee counties; Lower Peninsula, Emmet Co. (Burt, 1948:97), Iron Co., 2 mi. S Crystal Falls (Ozoga and Gaertner, 1963).

?*Sorex fumeus* Miller. SMOKY SHREW. Questionable status.

Distribution: Known by a single specimen from "Racine", Wisconsin. Possibly exterminated, but probably the locality data are incorrect on the specimen label.

Only record: Racine, Wisconsin (Jackson, 1961:35).

Sorex arcticus Kerr. ARCTIC SHREW. Also called saddle-backed shrew.

Sorex arcticus laricorum Jackson.

Aesthetic attributes: Pelage in attractive tricolor pattern. Remarkably voracious and small, as are other long-tailed shrews.

Value: Beneficial to man as a predator of injurious insects (Buckner, 1955). Arctic shrews cause no known harm to man.

Status and Distribution: Local but fairly abundant in distribution in wet, marshy habitats; occurring also in bogs and tamarack swamps. The number of preserved specimens is low, indicating that the species might be threatened.

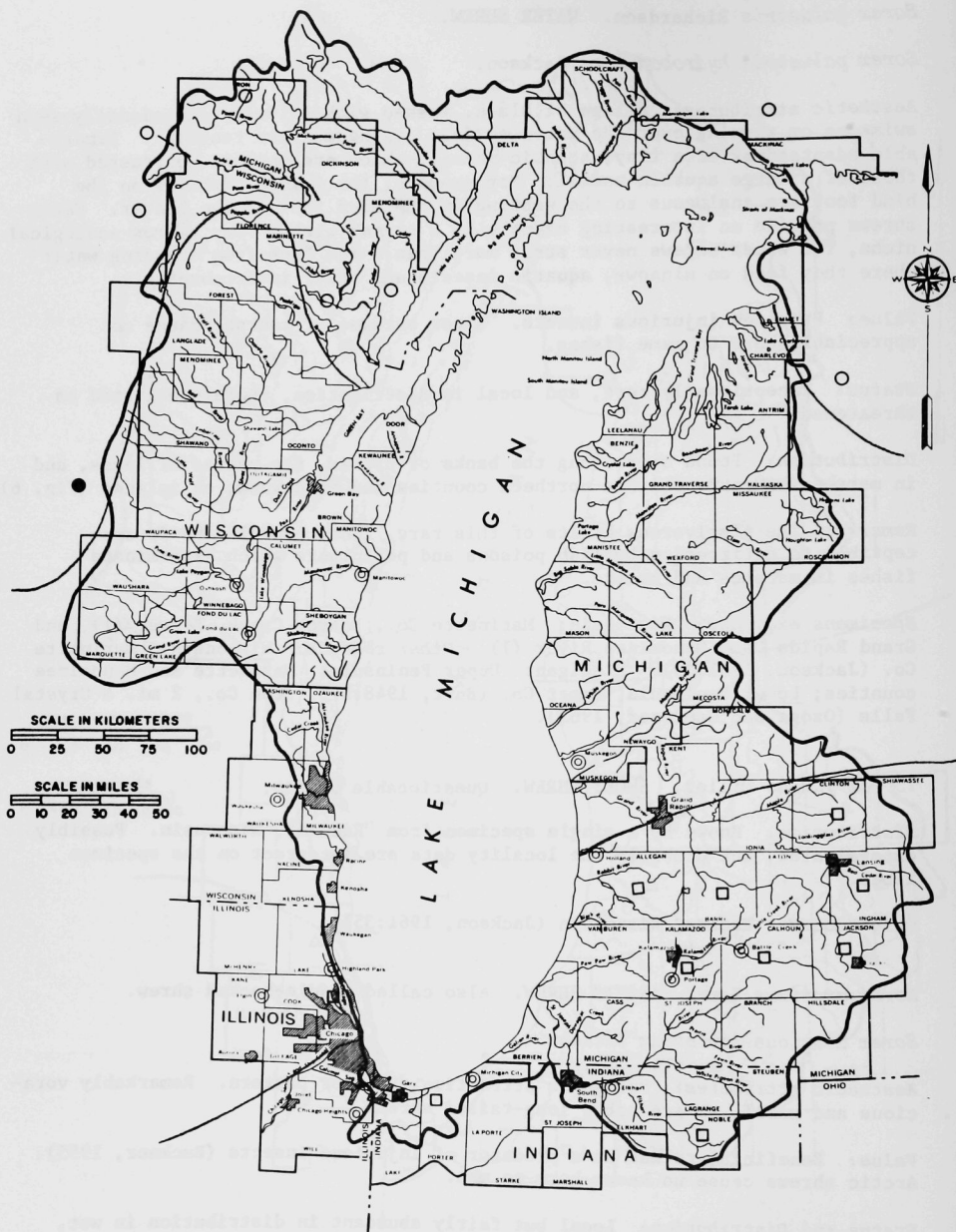


Fig. 6. Distribution of *Sorex palustris* (circles) and *Cryptotis parva* (squares).

Restricted from the extreme southern counties of Wisconsin, lower Michigan, all islands, and Illinois and Indiana. The Arctic shrew is known only along the western and northern boundary of the Lake Michigan drainage basin (Fig. 7), and probably occurs locally in some northern counties of upper Michigan. Numerous records from a few miles outside the watershed in Wisconsin and upper Michigan.

Specimens examined: None. *Other records*: Michigan: Iron Co. (Burt, 1948:94).

Microsorex hoyi (Baird). HOY'S PIGMY SHREW. *Microsorex hoyi intervectus* Jackson, known by Jackson as the Northwestern shrew, is considered a synonym (Long, 1972).

Microsorex hoyi hoyi (Baird).

Aesthetic attributes: Remarkably small, a southern subspecies is apparently as small as any mammal on earth. The species is always rare and even though its geographic range is vast the number of specimens in all museums scarcely exceeds 300.

Value: Similar to that of *Sorex cinereus*.

Distribution: Studies on the ecology of this species (Long, 1972; Spencer and Pettus, 1966) show that the shrew is boreal and prefers wet-dry situations where water is less than 100 meters away. Known in upper Michigan and northern Wisconsin, the species hardly ranges into the Lake Michigan drainage basin (Fig. 8).

Specimens examined: None. *Other records*: Wisconsin: Oconto Co., Lakewood (Jackson, 1961:42). Michigan: Marquette and Menominee counties, Upper Peninsula (Burt, 1948:98 and Long, 1972a).

Remarks: Long (1972a) separated *Microsorex hoyi* and *M. thompsoni* as full species, listed *M. intervectus* Jackson as a synonym, and assigned small, eastern shrews to *M. thompsoni*, and larger shrews of northern Wisconsin to *M. hoyi*.

Microsorex thompsoni (Baird). THOMPSON'S PIGMY SHREW. Known by Jackson as *M. hoyi hoyi*, the American pigmy shrew, but see Long, 1972a.

Microsorex thompsoni thompsoni (Baird).

Aesthetic attributes and Values: Similar to those of other long-tailed shrews, although *M. thompsoni* is apparently as small (2.2 grams minimum) as any mammal on earth and therefore merits study of its metabolism and behavior.

Status: This species appears to be more uncommon even than *M. hoyi*, is obviously threatened if not extinct in the Lake Michigan drainage basin, and is extremely rare throughout its range in the United States and Canada (Long, 1972a; 1972b).

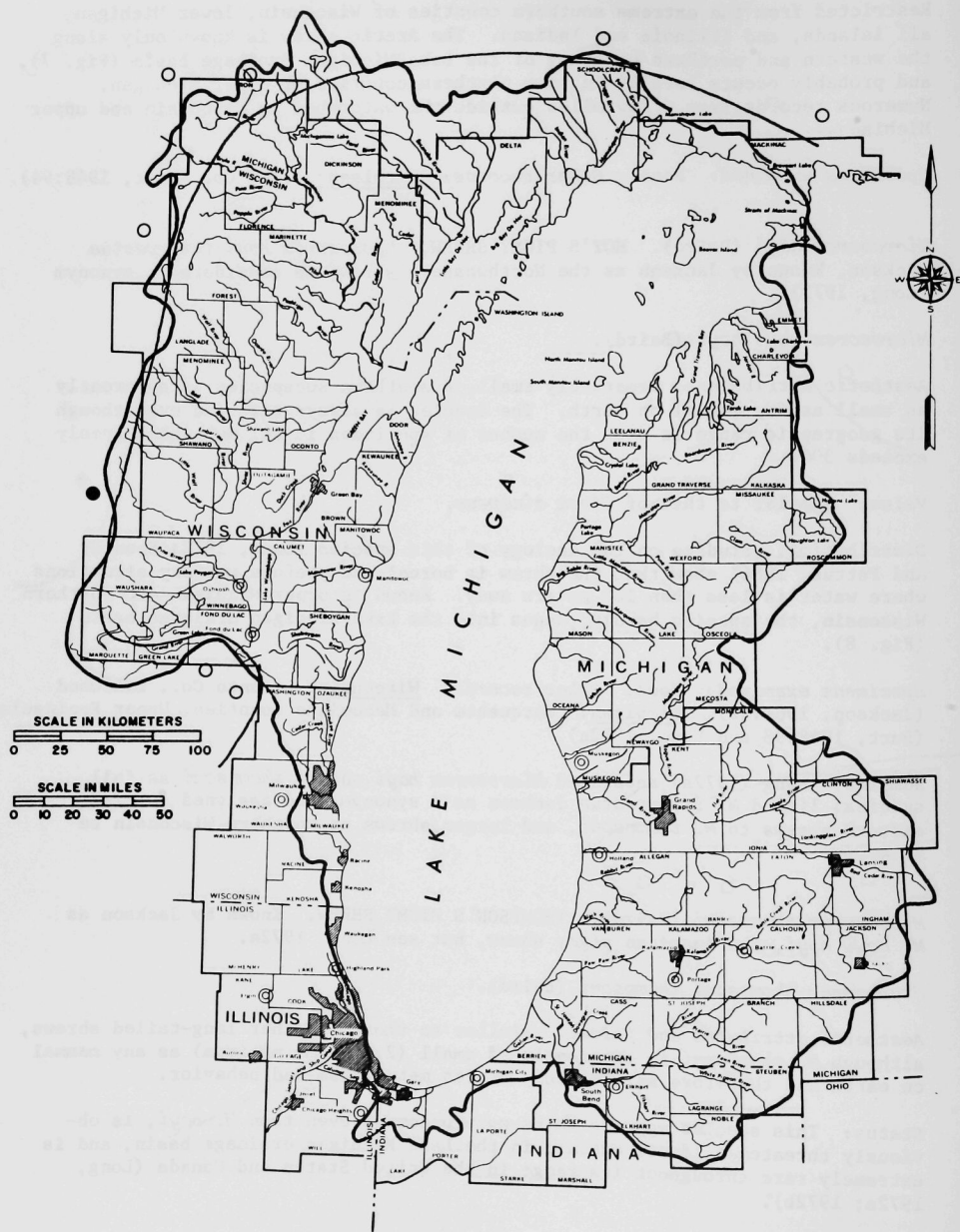


Fig. 7. Distribution of *Sorex arcticus*.

Distribution: Known only from Milwaukee and Palatine (Chicago area), Illinois. The "Racine" holotype is *M. hoyi* (see Long, 1972a). One specimen in Presque Isle Co., lower Michigan (Long, 1972) occurs near the Lake Michigan drainage (Fig. 8). The specimen from Palatine is missing in the Field Museum collection (personal correspondence, P. HersHKovitz, Dr. Luis de la Tore) and until it is found the assignment of the specimen is provisional, based on geographic grounds.

Specimens examined: Wisconsin: Milwaukee Co., Milwaukee (2), Milwaukee Public Mus. *Other records:* Illinois: Palatine, Chicago area (Sanborn and Tibbitts, 1949).

Blarina brevicauda (Say). SHORT-TAILED SHREW. Also called mole shrew, lake states mole shrew.

Blarina brevicauda kirtlandi Bole and Moulthrop.

Aesthetic attributes: Dark velvet-gray pelage. Remarkable for being the only significantly venomous (see Pearson, 1942) mammal in the United States, and one of only a few in the world. The venom will kill mice but is not harmful to man. It exhibits the voracious and "nervous" behavior of all insectivores.

Value: This shrew preys on numerous injurious insects and rodents and is therefore beneficial to man. *Blarina* is a small predator that is itself situated low in food chains, preyed on by owls, foxes, and other predators.

Distribution: Abundant throughout the Lake Michigan drainage basin (Fig. 9) the short-tailed shrew is common in marshes, hardwood forests, and prairies but rare in swamps and dense, boreal coniferous (hemlock-balsam) stands.

Specimens examined: Wisconsin: Forest Co., Popple River, Town of Popple River (2), Pickerel Lake (1), and Alvin (2); Marinette Co., 1 mi. E Beaver (1); Door Co., 6 mi. W Sturgeon Bay (1); Kewaunee Co., 2 mi. S Algoma (1), 2 mi. N Algoma (1); Oconto Co., Mountain (1); NE 1/4 Sect. 22, T28W, R19E (1); Manitowoc Co., 1 mi. N Manitowoc (5), Manitowoc (2); Portage Co., Tomorrow River Public Hunting Ground (1), 2 1/2 mi. NW Nelsonville (1); Marquette Co., Harrisville (1); Racine Co., Wind Lake, Racine (2); Kenosha Co., 8 1/2 mi. W Kenosha (1). *Other records:* Wisconsin: Numerous counties (Jackson, 1961:55 and McCabe, 1972). Michigan: Numerous counties of Upper and Lower Peninsulas of Michigan (Burt, 1948:103), Marion Island (Dice, 1925). Illinois: Fox Lake, Lake Co.; Chicago, Cook Co. (Cory, 1912:428). Indiana: Five northern counties (Lyon, 1936).

Cryptotis parva (Say). LEAST SHREW. Also called Indiana little short-tailed shrew, little mole shrew, brown little short-tailed shrew.

Cryptotis parva harlani (Duvernoy).

Aesthetic attributes: Beautiful brown, felt-like pelage. Remarkably small, especially compared in total length to other mammals. In the Lake Michigan watershed the least shrew is the only shrew found primarily in dry prairies.

Value: This species is beneficial to man as a predator of insects.

Status: Rare and marginal, the least shrew should be listed as threatened in all states adjacent to Lake Michigan. R. H. Baker (*in litt.*, 1973) and his students have obtained no specimens in southern Michigan since 1955.

Distribution: Ranges into the Lake Michigan drainage basin only in Indiana, southern third of lower Michigan, and possibly into northern Illinois. In central Wisconsin two specimens are known from prairies lying west of the basin (Fig. 6).

Specimens examined: None. *Other records:* Michigan: Clinton, Allegan, Barry, Ingham, Kalamazoo, Calhoun, and Jackson counties (Burt, 1948:100). Illinois: Cook County, Homewood (Necker and Hatfield, 1941). Indiana: Porter and Noble counties (Lyon, 1936).

ORDER CHIROPTERA--BATS

VESPERTILIONIDAE - EVENING BATS

Myotis lucifugus (Le Conte). LITTLE BROWN BAT.

Myotis lucifugus lucifugus (Le Conte). This species resembles *Myotis sodalis* and *Myotis keenii*, and to a lesser extent *Nycticeius humeralis*. *Myotis sodalis* and *M. keenii* have abruptly rising braincase and lack the brassy glint of the pelage. The ear of *M. keenii* is a parabola, long and wide, and always extends several or more millimeters beyond the snout. The calcar usually lacks a keel in *M. lucifugus*.

Aesthetic attributes: The pelage of this tiny mammal is a beautiful soft brown with a metallic sheen. This bat is a fairly abundant flying mammal, whereas the other aerial mammals are uncommon. Little brown bats excite many outdoorsmen who see them, and there are many people who enjoy exploring caves where the bats sometimes hibernate in abundance. They disperse from hibernacula to old houses, forests and towns in warmer months.

Values: The little brown bat is probably the most efficient nocturnal predator of flying insects in the Lake Michigan region. Some individuals may become the vectors of rabies, thus some populations of bats represent a reservoir in nature for this terrifying disease. Actually, in comparison to dogs and cats, bats seldom transmit rabies to man.

Status: Abundant, especially in northern counties. The concentration of hibernating bats in caves makes them highly susceptible to extirpation.

Distribution: Found throughout the area, especially in northern counties.

Specimens examined: Wisconsin: Langlade Co., Perch Lake, T34N, R11E, (9); Portage Co., Upper Tomorrow River, Heig's farm (10); Waupaca Co., Waupaca (9); Door Co., 15 mi. N Sturgeon Bay (4); 5 mi. N Sturgeon Bay (1); Manitowoc Co., Manitowoc (4); Milwaukee Co., Milwaukee, Mil. Mus. (9). **Other records:** Wisconsin: Numerous counties (Jackson, 1961:81 and McCabe, 1972). Michigan: Marquette, Delta and Menominee counties of upper Michigan; Emmet, Charlevoix, Antrim, Leelanau, Wexford, Oceana, and Kalamazoo counties of lower Michigan (Burt, 1948:106). Garden and Beaver islands (Phillips *et al.*, 1965; Ozoga and Phillips, 1964). Illinois: Cook and Lake counties (Necker and Hatfield, 1941). Indiana: La Grange Co. (Lyon, 1936).

Myotis keenii (Merriam). KEEN'S MYOTIS. Also called eastern long-eared bat.

Myotis keenii septentrionalis (Trouessart).

Aesthetic attributes and Values: Same as for *M. lucifugus*.

Status: In the Lake Michigan region *M. keenii* is less common than the little brown bat. All hibernators in the basin are threatened species, including *M. keenii*, because in winters the bats congregate in caves and are then susceptible to extermination.

Distribution: Keen's *Myotis* probably occurs throughout the Lake Michigan region but is more abundant in southern counties, particularly in winter, when the species hibernates in caves probably south and west of the region (Fig. 10).

Specimens examined: None. Specimens are available from Portage County in the nearby Wisconsin River drainage. *Other records:* Michigan: Marquette and Dickinson counties, upper Michigan; Emmet County, Lower Peninsula (Burt, 1948). Illinois: Cook County (Necker and Hatfield, 1941).

Lasionycteris noctivagans (Le Conte). SILVER-HAIRED BAT.

Aesthetic attributes: Pelage is a unique blend of black and silver. This bat is rare and migratory and hangs by day in hardwood trees (often in hollows and cavities).

Values: The silver-haired bat feeds primarily on nocturnal flying insects.

Status: Judged by preserved specimens this species is exceptionally rare and should be listed as a threatened species in the Lake Michigan region. Snyder had identified them as abundant in Beaver Dam, Wisconsin, with as many as 300 roosting in one house, but Jackson (1961:85) disparaged the identification.

Distribution: Occurs usually in deciduous forests along streams and the shores of lakes. Probably occurs throughout the Lake Michigan region (Fig. 10).

Specimens examined: Wisconsin: Sheboygan Co., Cedar Grove (1); Milwaukee (7) Mil. Mus. *Other records:* Wisconsin: Milwaukee and Racine counties (Jackson, 1961:86). Michigan: Kalamazoo Co., Ingham Co. (scattered records outside watershed throughout state) (Burt, 1948:111); South Manitou Island (Scharf, 1973). Illinois: Chicago (Cory, 1912:464). Indiana: Porter, Laporte, and St. Joseph counties (Lyon, 1936).

Eptesicus fuscus (Palisot de Beauvois). BIG BROWN BAT.

Eptesicus fuscus fuscus (Palisot de Beauvois).

Aesthetic attributes and Values: Similar to those of *Myotis lucifugus*. Whitaker (1972) found the species to prey mainly on beetles in Indiana.

Status: Uncommon in wilderness, although usually found in small numbers in caves in winter, this species is locally abundant in some settlements of man, and is often a pest in houses. As are all hibernating bats, the species is threatened by concentrating its populations into a few caves. Maternity colonies are uncommon.

Distribution: Occurs throughout the Lake Michigan region except perhaps on some of the islands. Uncommon in northern counties (Fig. 11).

Specimens examined: Wisconsin: Door Co., 5 mi. S Egg Harbor, 15 mi. N Sturgeon Bay (2), and 5 mi. N Sturgeon Bay (1); Waukesha Co., Waukesha (1) Mil. Mus.; Milwaukee (1) Mil. Mus., Racine Co., Racine, Hwy 38 (1). *Other records:* Wisconsin: Brown Co., Green Bay; Waukesha Co. (Jackson, 1961:91-93).

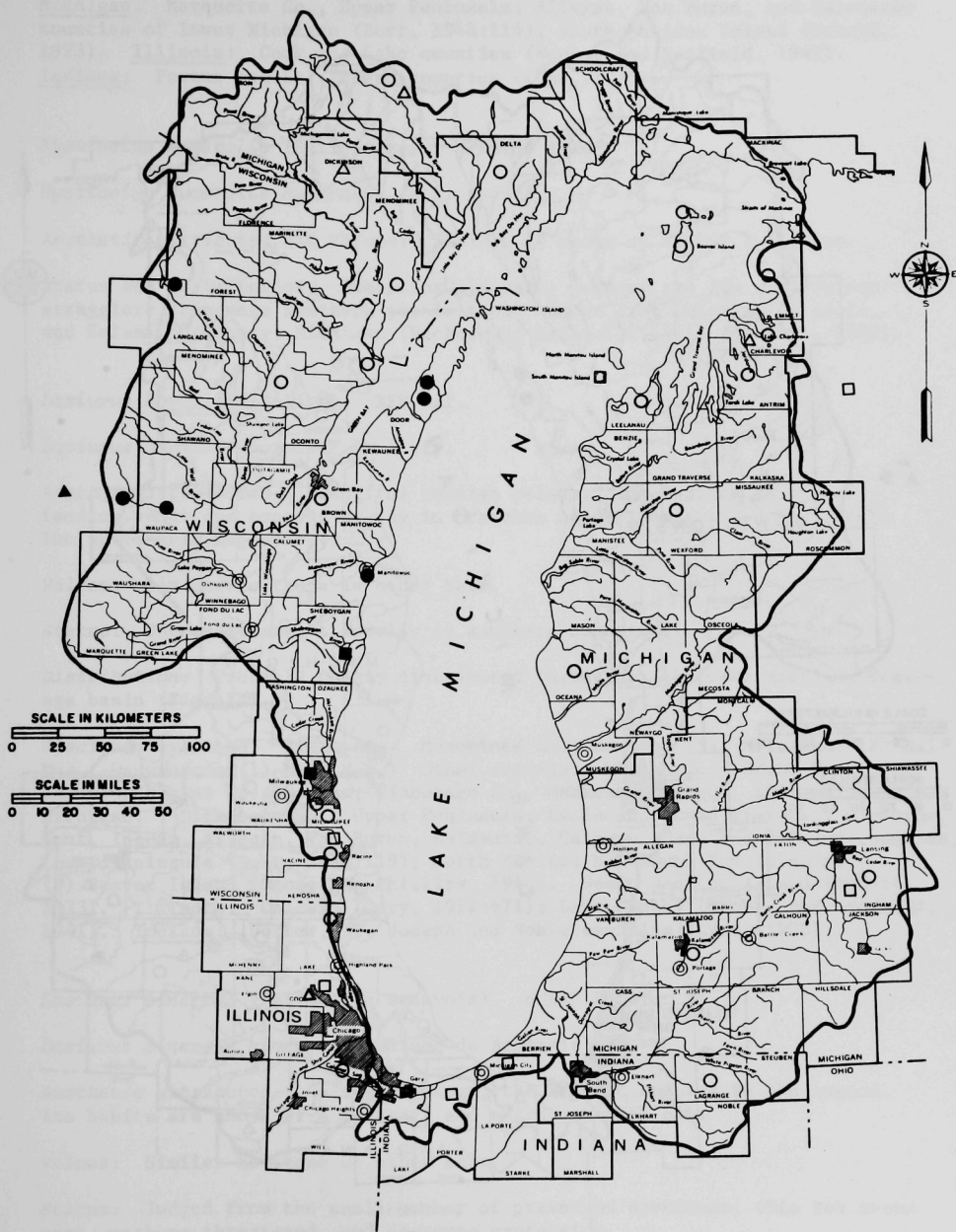


Fig. 10. Distribution of *Myotis lucifugus* (circles), *M. keenii* (triangles), and *Lasionycteris noctivagans* (squares).

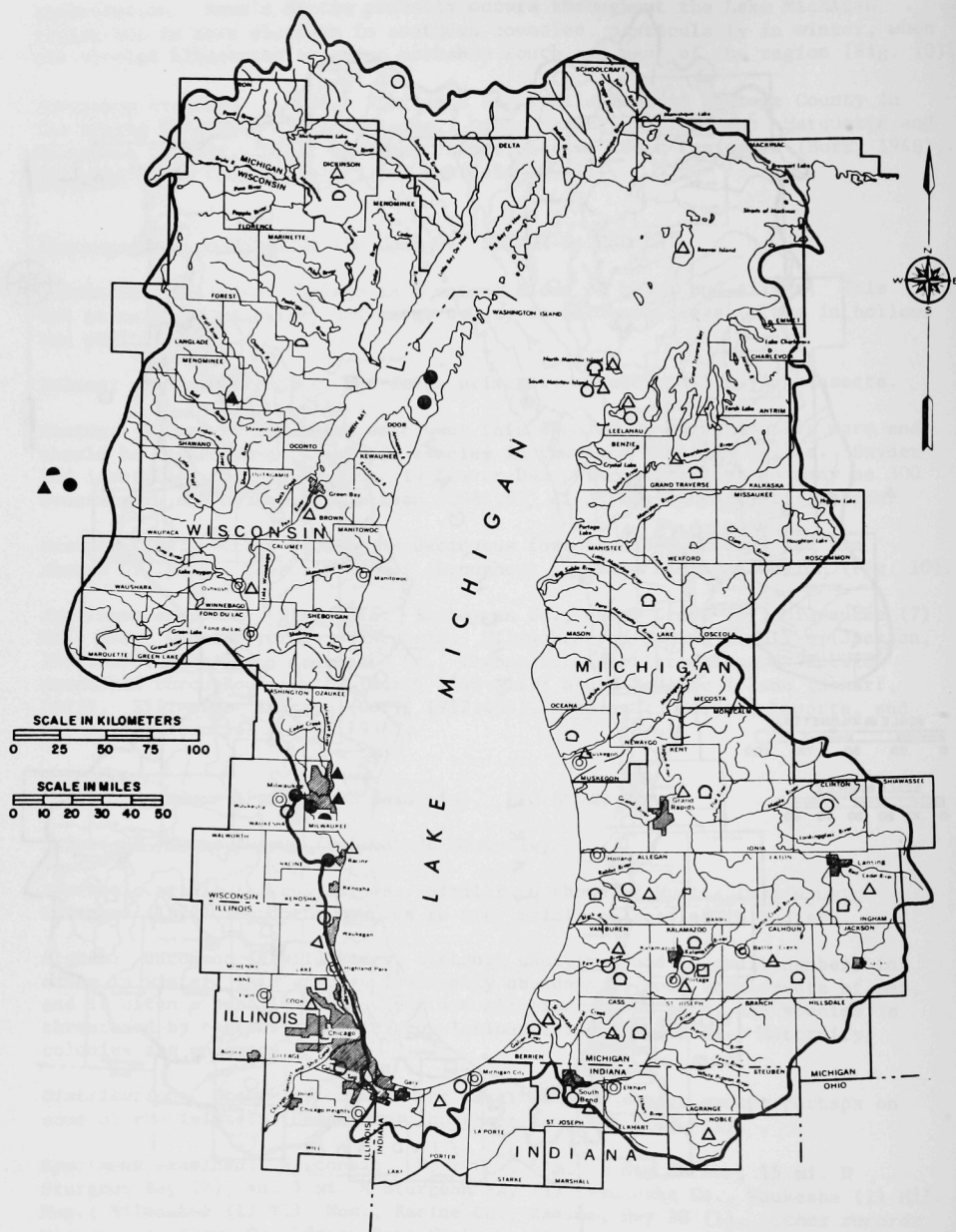


Fig. 11. Distribution of *Eptesicus fuscus* (circles), *Lasiurus cinereus* (semi-circles), *L. borealis* (triangles), and *Nycticeius humeralis* (squares).

Michigan: Marquette Co., Upper Peninsula; Allegan, Van Buren, and Kalamazoo counties of lower Michigan (Burt, 1948:114); South Manitou Island (Scharf, 1973). Illinois: Cook and Lake counties (Necker and Hatfield, 1941). Indiana: Porter and St. Joseph counties (Lyon, 1936).

Nycticeius humeralis (Rafinesque). EVENING BAT.

Nycticeius humeralis humeralis (Rafinesque).

Aesthetic attributes and Values: Similar to those of *Myotis lucifugus*.

Status and Distribution: Exceptionally rare; perhaps the few records are stragglers from more southern populations. Known from Chicago, Illinois, and Kalamazoo County, Michigan (Necker and Hatfield, 1941; and Burt, 1948).

Lasiurus borealis (Muller). RED BAT.

Lasiurus borealis borealis (Muller).

Aesthetic attributes: Beautiful reddish pelage. Interesting habits of feeding about and hanging by day in branches of deciduous trees and shrubs. The species is migratory.

Values: Similar to those in other bats.

Status: Uncommon, except locally in southern counties.

Distribution: Probably thinly distributed throughout the Lake Michigan drainage basin (Fig. 11).

Specimens examined: Wisconsin: Menominee Co., Keshena (1); Milwaukee (2) Mil. Mus.; Wauwautosa (1) Mil. Mus.) *Other records*: Wisconsin: Brown Co., Allouey; Racine Co., Racine; Winnebago Co., Oshkosh (Jackson, 1961:98). Michigan: Dickinson Co., Upper Peninsula; Leelanau, Grand Traverse, Muskegon, Kent, Ingham, Allegan, Van Buren, Kalamazoo, Calhoun, Cass and Berrien counties, Lower Peninsula (Burt, 1948:119); North Manitou and South Fox islands. (?) Beaver Island (Ozoga and Phillips, 1964). South Manitou Island (Scharf, 1973). Illinois: Chicago (Cory, 1912:471); Lake County (Necker and Hatfield, 1941). Indiana: Porter, St. Joseph and Noble counties (Lyon, 1936).

Lasiurus cinereus (Palisot de Beauvois). HOARY BAT.

Lasiurus cinereus cinereus (Palisot de Beauvois).

Aesthetic attributes: Colorful pelage; the largest species in the region. Its habits are those of a solitary and migratory tree bat.

Values: Similar to those of other bats.

Status: Judged from the small number of preserved specimens, this bat seems rare, perhaps threatened, and deserves protection.

Distribution: Prefers conifers and is probably more abundant in northern counties (Fig. 11).

Remarks: On 18 August 1968, I observed a hoary bat flying at Chipmunk Rapids.

Specimens examined: A specimen was observed from Stevens Point, Wisconsin, and another from Portage County was possibly collected from the Lake Michigan drainage basin. Six hoary bats from Milwaukee examined in Mil. Mus. *Other records:* Wisconsin: Oconto Co., Kelly Lake (Jackson, 1961). Michigan: Dickinson Co., Upper Peninsula; Leelanau, Grand Traverse, Muskegon, Kent, Allegan, Ingham, Van Buren, Kalamazoo, Calhoun, Berrien, and Cass counties of lower Michigan (Burt, 1948:118); Lake Co., 3 mi. NW Luther (Denys, 1972). South Manitou Island (Scharf, 1973). Illinois: Chicago (Cory, 1912:474). Indiana: Lake and St. Joseph counties (Lyon, 1936).

ORDER LAGOMORPHA--RABBITS AND HARES

LEPORIDAE - RABBITS AND HARES

Sylvilagus floridanus (J. A. Allen). EASTERN COTTONTAIL. Also called Mearns' cottontail.

Sylvilagus floridanus mearnsii (J. A. Allen).

Aesthetic attributes: Soft fur, large eyes, and gentle behavior endear the cottontail, especially to children. This species is popular in children's literature and mythology and is a part of the American heritage. Reproductive behavior includes maternal care of young born naked and blind in a fur-lined nest.

Values: Popular game mammals and a useful food resource. At times the fur is marketable. In the wilderness rabbits are essential herbivores in food chains involving birds of prey (especially the great horned owl) and fur-bearing mammals (especially the red fox). Small rabbits are often preyed upon by large snakes. The cottontail is especially injurious to garden plants and, in winter, to orchards, saplings, and shrubs. Rabbits are vectors for the dangerous disease tularemia.

Status: Abundant, probably much more so in northern counties since man altered forest habitats there to meadows, settlements, and brushland. McCabe (1972) quotes Leopold's statement that the cottontail invaded Forest Co. in 1914. The absence of this species on some islands supports the hypothesis (see Jackson, 1961:116) that cottontails spread recently into the northern pinery.

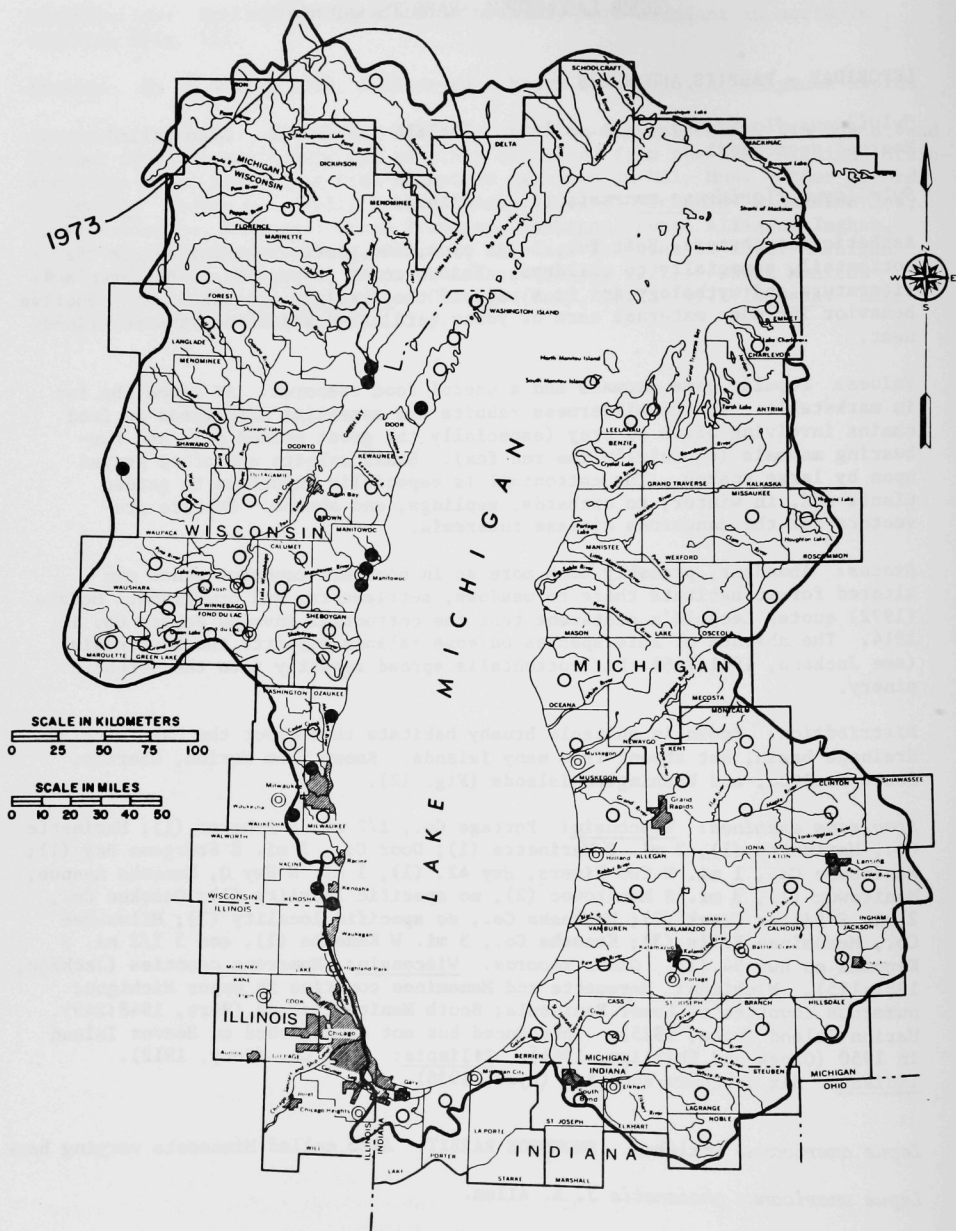
Distribution: Known in suitable brushy habitats throughout the Lake Michigan drainage basin, but absent from many islands. Known from Marion, Charity, South Manitou, and Washington islands (Fig. 12).

Specimens examined: Wisconsin: Portage Co., 1/2 mi. S Amherst (1); Marinette Co., Marinette (1), 2 mi. S Marinette (1); Door Co., 3 mi. E Sturgeon Bay (1); Manitowoc Co., 1 mi. N Two Rivers, Hwy 42, (1), 1 mi. N Hwy Q, Menasha Avenue, Manitowoc (1), 3 mi. S Manitowoc (2), no specific locality (1); Ozaukee Co., 2 mi. S Silver Creek (2); Waukesha Co., no specific locality (2); Milwaukee Co., Menominee Falls (3); Kenosha Co., 5 mi. W Kenosha (1), and 3 1/2 mi. S Kenosha on Hwy 94 (1). **Other records:** Wisconsin: Numerous counties (Jackson, 1961:115). Michigan: Marquette and Menominee counties in upper Michigan; numerous counties of Lower Peninsula; South Manitou Island (Burt, 1948:249). Marion Island (Dice, 1925). Introduced but not established on Beaver Island in 1950 (Ozoga and Phillips, 1964). Illinois: Lake Co. (Cory, 1912). Indiana: Six northern counties (Lyon, 1936).

Lepus americanus Erxleben. SNOWSHOE RABBIT. Also called Minnesota varying hare.

Lepus americanus phaeonotis J. A. Allen.

Aesthetic attributes: The rich brown pelage in summer and, after molting, pure white in winter, makes this rabbit especially endearing. The author has picked



up young snowshoe rabbits in a marsh in Portage County, Wisconsin, seemingly unafraid and appearing tame. Remarkable attributes are molting of pelage to protective white, the "snowshoe" adaptation of the feet to supporting weight in deep snow; the cycles of abundance and scarcity (Green and Evans, 1940), gamboling and thumping (with hind legs), gregarious behavior, and the reproductive trait of building no nest ascribed to hares.

Values: The valuable traits of the cottontail are likewise those of the snowshoe rabbit. Popular as game animals and hunted with guns, bow and arrow, and hounds, the snowshoe rabbit is also a food resource. Threatened species such as bald eagles, Canada lynx and fisher prey extensively on this herbivore, as do other predators, large (coyote) and small (ermine). Its wilderness habitat precludes much of the destructiveness of *Sylvilagus* (except in forest nurseries).

Status: Abundant in appropriate habitats (brushy marshes, woodlands, particularly mixed conifers and deciduous trees, swamps, fallen trees and alder thickets) of northern counties, the species formerly ranged southward of its present range.

Distribution: Confined now to northern counties and occurring on most large islands in Lake Michigan (Fig. 13).

Specimens examined: Wisconsin: Forest Co., northern part (1); Florence Co., Purdue Science Camp, Chipmunk Rapids (1); Marinette Co., 7 mi. W Pembine (1); Oconto Co., no specific locality (1); Door Co., 3 mi. E Sturgeon Bay (1). Other records: Wisconsin: Numerous counties (Jackson, 1961:110). Michigan: Numerous counties of Upper Peninsula, numerous islands, many northern counties of Lower Peninsula (Emmet, Charlevoix, Antrim, Leelanau, Grand Traverse, Osceola, Ionia, Ingham, Allegan (southmost record) (Burt, 1948:244). Indiana: Lake, Porter and Laporte counties (Lyon, 1936).

Lepus townsendii Bachman. WHITE-TAILED JACK RABBIT.

Lepus townsendii campianus Hollister.

Aesthetic attributes: Resembles those of *Lepus americanus*, except the white-tailed jack is an enormous hare seldom seen, and it does not run to cover but escapes by leaping away, over the open marshes or prairies. The species illustrates interesting saltatorial adaptations and cryptic coloration, as well as pelage change to white in winter.

Values: The species is a protected game animal and a source of meat. The fur is valued for felt, but the numbers of this rare hare are too low for much profit. Though its habits are injurious to crops, the low numbers of this species seldom permit it to cause significant damage.

Status: Locally present in small populations in open country, a habitat type which is diminishing resulting in the species being threatened. The species is perhaps less abundant than in 1951-52 (Jackson, 1961:106). It was probably introduced into the Lake Michigan drainage region.

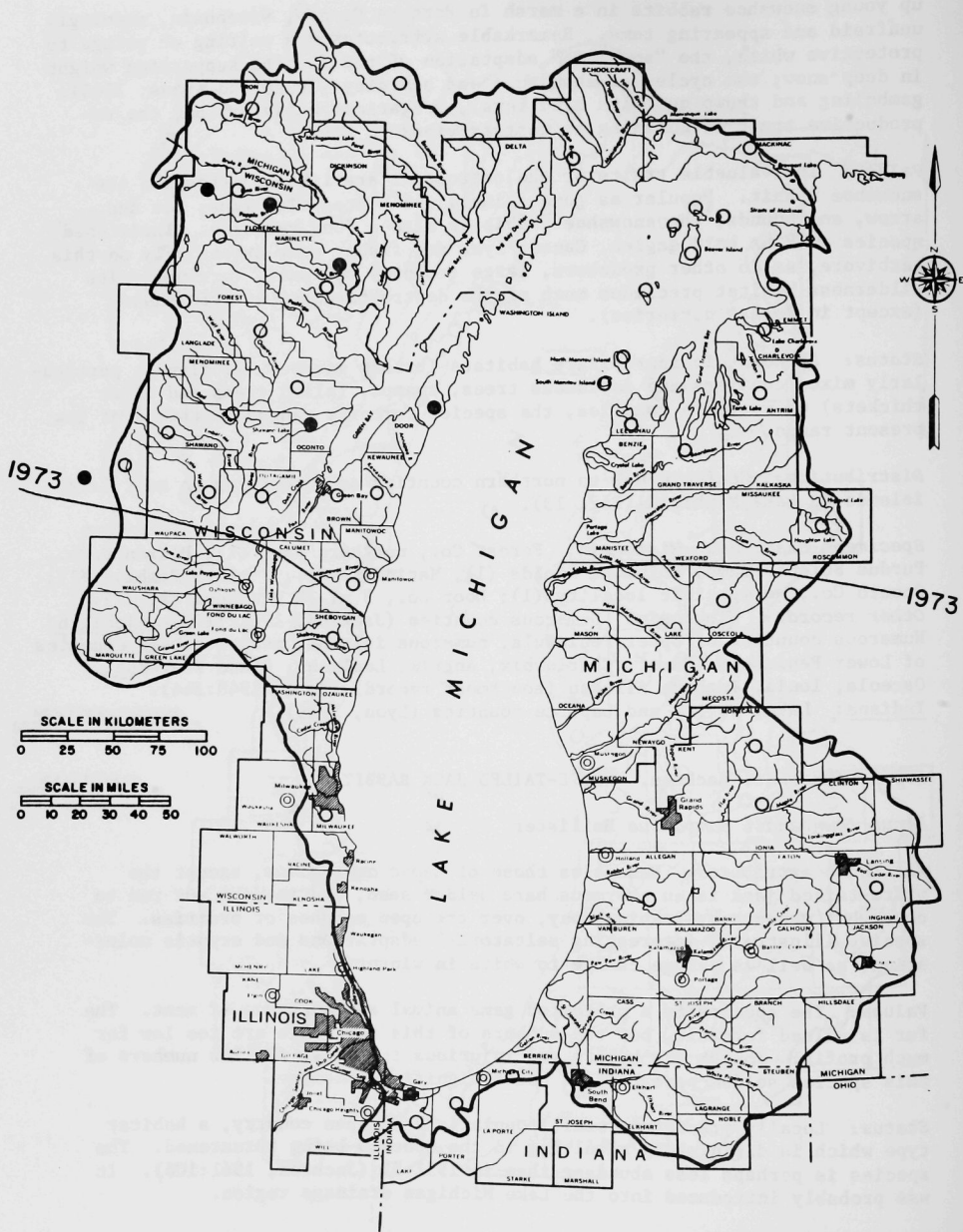


Fig. 13. Distribution of *Lepus americanus*. Boundary denotes present known range; former range throughout entire watershed.

Distribution: Apparently wide-spread in appropriate habitats along the western shore of Lake Michigan, but restricted from Door County above Sturgeon Bay and from the densely forested northern counties, as well as from the islands in Lake Michigan and all of Michigan (Fig. 14).

Specimens examined: None from within basin. One specimen examined from the Buena Vista Marsh, Portage County, Wisconsin, a few miles from the Lake Michigan's watershed. *Other records:* Wisconsin: Numerous counties (Jackson, 1961:105).

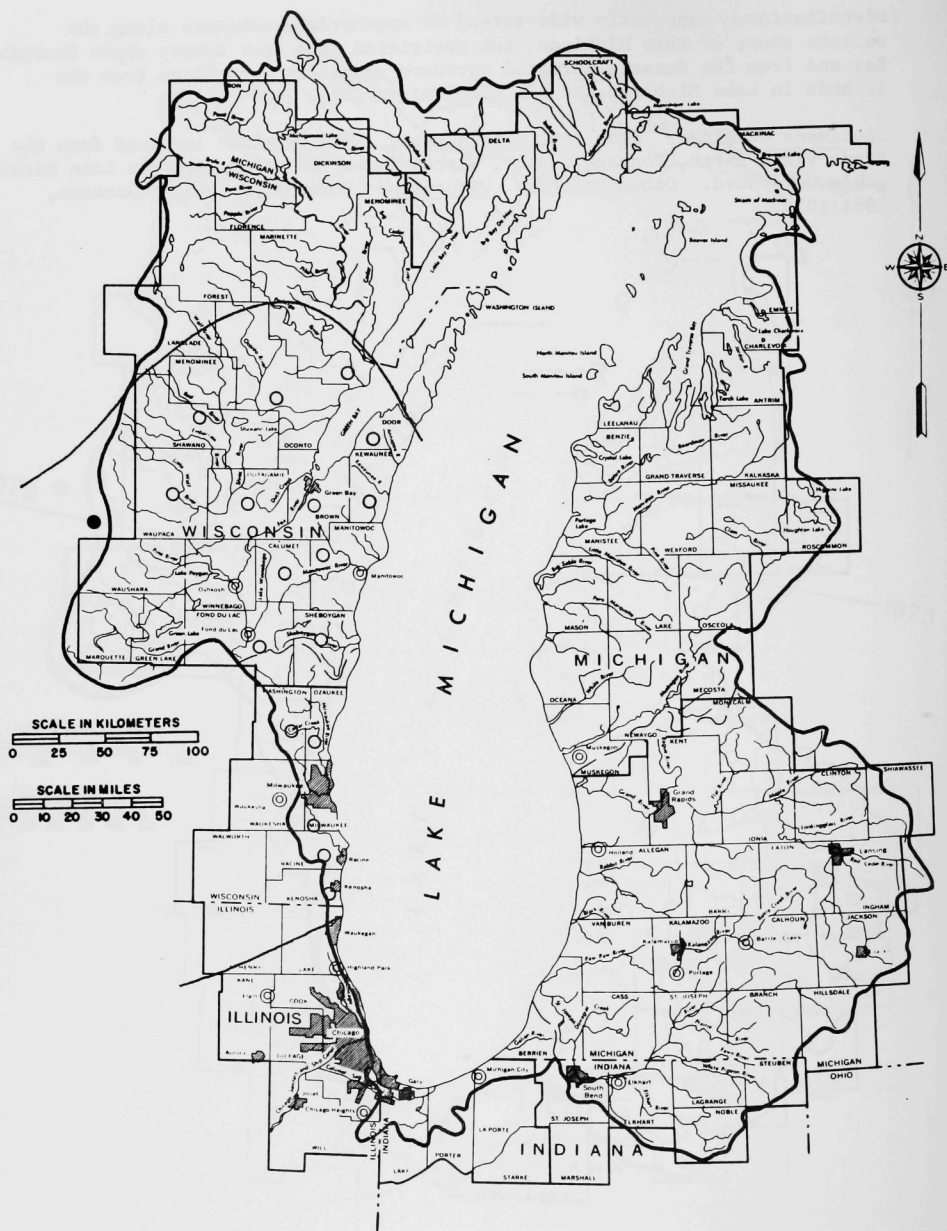


Fig. 14. Distribution of *Lepus townsendii*.

ORDER RODENTIA--RODENTS

SCIURIDAE - SQUIRRELS

Tamias striatus (Linnaeus). EASTERN CHIPMUNK. Also called gray chipmunk, striped chipmunk, Ohio chipmunk, Peninsula chipmunk, brown chipmunk, etc. There are four subspecies in the region, listed below.

Aesthetic attributes: A beautifully striped mammal, with large eyes and alert demeanor, nearly tame at parks and campgrounds. Remarkable ground-arboreal niche, climbing to heights of 100 feet to harvest cones and seeds, or burrowing in the ground to store them. This species hibernates, but may arouse especially on warm days.

Values: Feeds primarily on acorns, seeds, pine cones, flower parts, and insects. Causes little harm, although it burrows in flower beds. Numerous predators prey on this little squirrel, including boys and domestic cats and dogs.

Status: Abundant throughout watershed. Prefers open woodlands. Perhaps locally threatened.

Distribution: Fig. 15.

Tamias striatus griseus Mearns.

Specimens examined: Wisconsin: Forest Co., Crandon (2); Pickerel Lake (4); Marinette Co. 8 mi. N Marinette, near Menominee River (1), 9 mi. NW Crivitz (1); Oconto Co., 5 mi. NE Suring (1); Waupaca Co., Waupaca (1), Tomorrow River Hunting Ground (1); Manitowoc Co., Manitowoc (5), 2 mi. E Valders (1); Sheboygan Co., Random Lake (1). Michigan: Schoolcraft Co., 4 mi. N Manistique (2); Delta Co., 15 mi. E Escanaba, on Stonington Peninsula (1). *Other records:* Wisconsin: Numerous counties as far south as Marquette, Green Lake, Fond du Lac, and Calumet (Jackson, 1961:144). Michigan: Upper Peninsula, all counties of watershed (Burt, 1948:184), South Fox islands (Hooper, 1942).

Remarks: The specimen from 2 mi. E Valders is dark brown, resembling *T. s. ohionensis*, but the specimen from Random Lake, between Valders and Milwaukee, is inseparable from typical *T. s. griseus*.

Tamias striatus doorsiensis Long.

Aesthetic attributes: Similar to those of *T. s. griseus* but *T. s. doorsiensis*, being brighter and paler, is much more striking and "fairer" (Long, 1971).

Status and Distribution: Locally abundant on the Door Peninsula (Fig. 15), but threatened nevertheless because of a very restricted geographic range and by the invasion of the Door Peninsula by modern man desiring to alter natural habitats of the Peninsula (planting lawns, etc.).

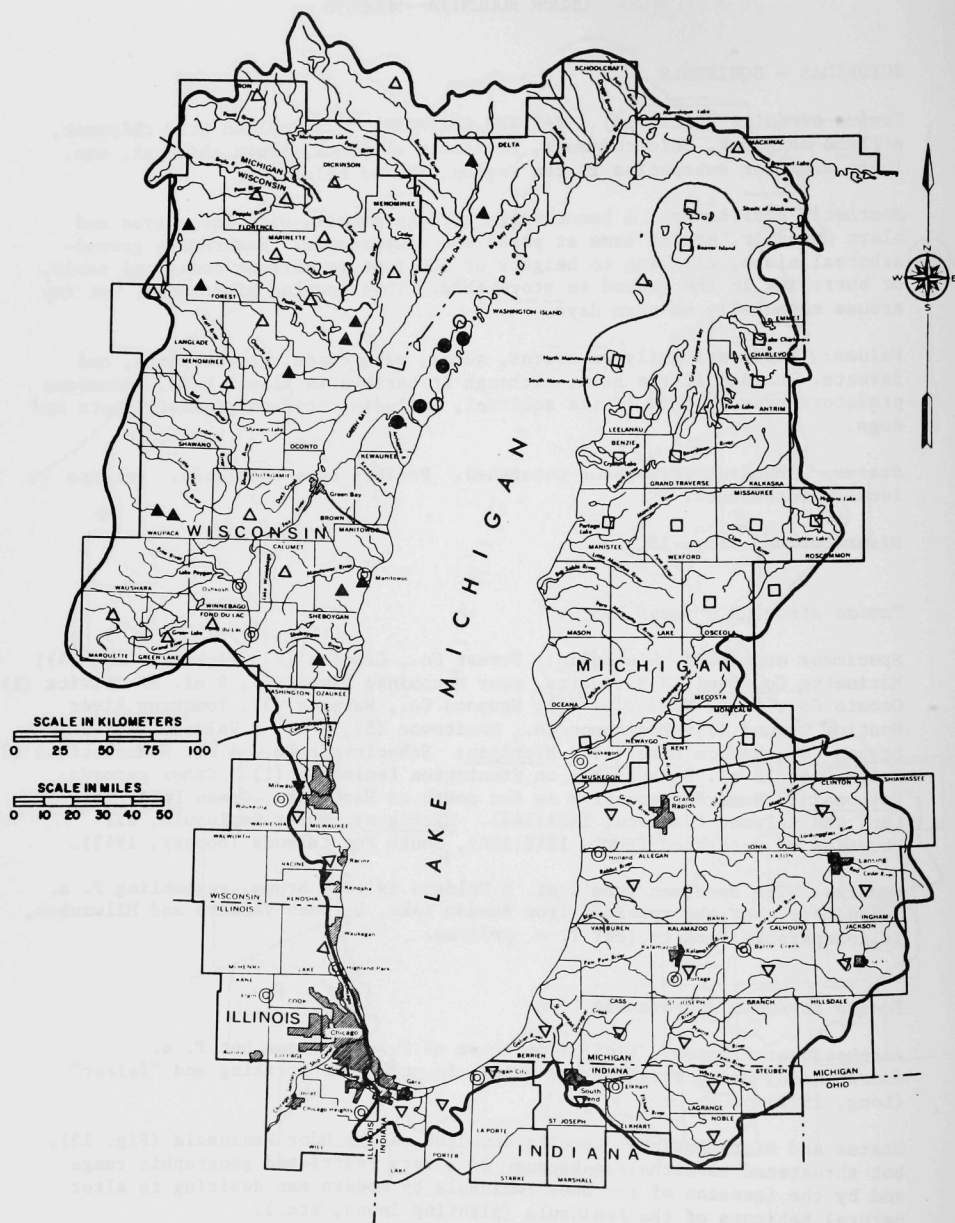


Fig. 15. Distribution of *Tamias striatus*. *T. s. griseus* (triangles), *T. s. dooriensis* (circles), *T. s. peninsulae* (squares), and *T. s. ohionensis* (inverted triangles).

Specimens examined: Wisconsin: Door Co., 3 mi. N Bailey's Harbor, on Hwy 57 (1), approx. 2 mi. N Jacksonport, at wayside (2), Peninsula State Park (16), Fish Creek (1), Sturgeon Bay (2), 6 mi. W Sturgeon Bay (5), 5 mi. SE Peninsula "center" (1). *Other records:* Wisconsin: Brown Co., Benderville and Red Banks; Door Co., Ellison Bay, and Newport (Jackson, 1961;149).

Tamias striatus peninsulae Hooper.

Status and Distribution: Locally abundant in northern counties of the Lower Peninsula of Michigan, and occurs on some islands (Burt, 1948) (Fig. 15).

Specimens examined: Lower Michigan: Charlevoix Co., Beaver Island, St. James (10). *Other records:* Lower Michigan: Antrim Co., Wetzel Lake; Charlevoix Co., Thumblake; Leelanau Co., 2 mi. S Leland, Leland, Mouth Traverse Creek; Manistee Co., Jct. Pine Creek and Big Manistee River; Muskegon Co., near Lake Michigan, N Muskegon Park; Osceola Co., Leroy; Beaver Island (Hooper, 1942). Garden Island (Phillips *et al.*, 1965). North and South Manitou islands (Hall and Kelso, 1959).

Remarks: A pale subspecies differing from pale *Tamias striatus doorsiensis* in its smaller postauricular patches; tail shorter, less whitish (guard hairs) and less intermixture of black; pelage less grayish, cheeks cinnamon and less ochraceous, feet more reddish, and underside of tail a shade darker. The skull is more flattened, less robust, nasals, rostrum, and zygoma narrower, and teeth less massive.

Tamias striatus ohionensis Bole and Moulthrop.

Specimens examined: Wisconsin: Kenosha Co., Silver Lake (1); Milwaukee Co., Currie Park (1). *Other records:* Wisconsin: Racine and Waukesha counties (Jackson, 1961). Michigan: Ottawa, Kent, Clinton, Allegan, Ingham, Kalamazoo, Calhoun, Jackson, Berrien, Cass, St. Joseph counties of southern parts of lower Michigan (Burt, 1948). Illinois: Lake Co., Fox Lake (Cory, 1912:133); Cook Co. (Necker and Hatfield, 1941). Indiana: Six northern counties (Lyon, 1936).

Remarks: *Tamias striatus ohionensis* resembles *Tamias striatus griseus*, but is duller and more brownish, slightly smaller, and possesses on the average slightly narrower skull. Burt (1943) provisionally referred these chipmunks to *T. s. rufescens*, commenting on their resemblance to *T. s. peninsulae*, *T. s. ohionensis*, and *T. s. griseus*.

Eutamias minimus (Bachman). LEAST CHIPMUNK.

Eutamias minimus neglectus (J. A. Allen).

Aesthetic attributes: Beautiful, alert, striped little squirrel of sunny coniferous or mixed coniferous forests; the species hibernates; an investigation of its selection of habitats in relation to these selected by *Tamias striatus* should prove interesting. Bold and quick, the spritely least chipmunks liven up a campground.

Values: Feeds on seeds, wild fruits, small nuts, and often on injurious forest insects. The least chipmunk in this region carries no known diseases of man (Jackson, 1961:153).

Status: Locally abundant in northern counties west of Lake Michigan, but losing habitat and range in some areas (Jackson, 1961 and Long, 1970).

Distribution: Unknown on islands in Lake Michigan and absent from Lower Peninsula of Michigan. Appears restricted from the Door Peninsula and from areas south of Green Bay (Fig. 16).

Specimens examined: Wisconsin: Florence Co., Chipmunk Rapids (3); Forest Co., Alvin (7); Oconto Co., Jct. Hwy T and 64 (2). Michigan: Delta Co., 15 mi. E Escanaba, on Stonington Peninsula (2). *Other records:* Wisconsin: Forest, Florence, Marinette, Oneida, Langlade, Oconto, Shawano counties, all north of the city of Green Bay (Jackson, 1961:150). Michigan: Upper Peninsula: All counties of watershed (Burt, 1948:181).

Marmota monax (Linnaeus). WOODCHUCK. Also called ground hog. The taxonomy of marmots in the Lake Michigan watershed is confused. A. H. Howell (1915) assigned some marmots of lower Michigan to *M. m. rufescens*, although *M. m. monax* was thought to occur at Ann Arbor and along the southern shore of the Lake. Burt (1943) assigns marmots west of the Lake to *M. m. rufescens* and east of the Lake to *M. m. monax*.

Marmota monax rufescens A. H. Howell

Aesthetic attributes: Large rufous brown squirrel of the sunny forest edge and possessing attributes of hibernation, fossorial adaptation, solitary social organization (compared to western marmots), and interesting ecological requirements.

Values: A game animal in many areas and a source of meat. Occasionally raids gardens and cultivated fields, or damages a hillside. It is not known to carry diseases of man. The meat, fur and hides could be used more by man.

Status and Distribution: Neither abundant, nor rare, it is a solitary mammal restricted from islands in Lake Michigan (Fig. 17).

Specimens examined: Wisconsin: Oconto Co. (1); Manitowoc Co., 7 mi. N Kiel (1). *Other records:* Wisconsin: Numerous counties north of and including Winnebago, Fond du Lac and Sheboygan counties (Jackson, 1961:124). Michigan: Numerous counties on Upper Peninsula (Burt, 1948:176).

Marmota monax monax (Linnaeus).

Attributes, Values and Status: As in *Marmota monax rufescens*.

Distribution: Lower Peninsula of Michigan and northern Illinois and Indiana (Fig. 17).

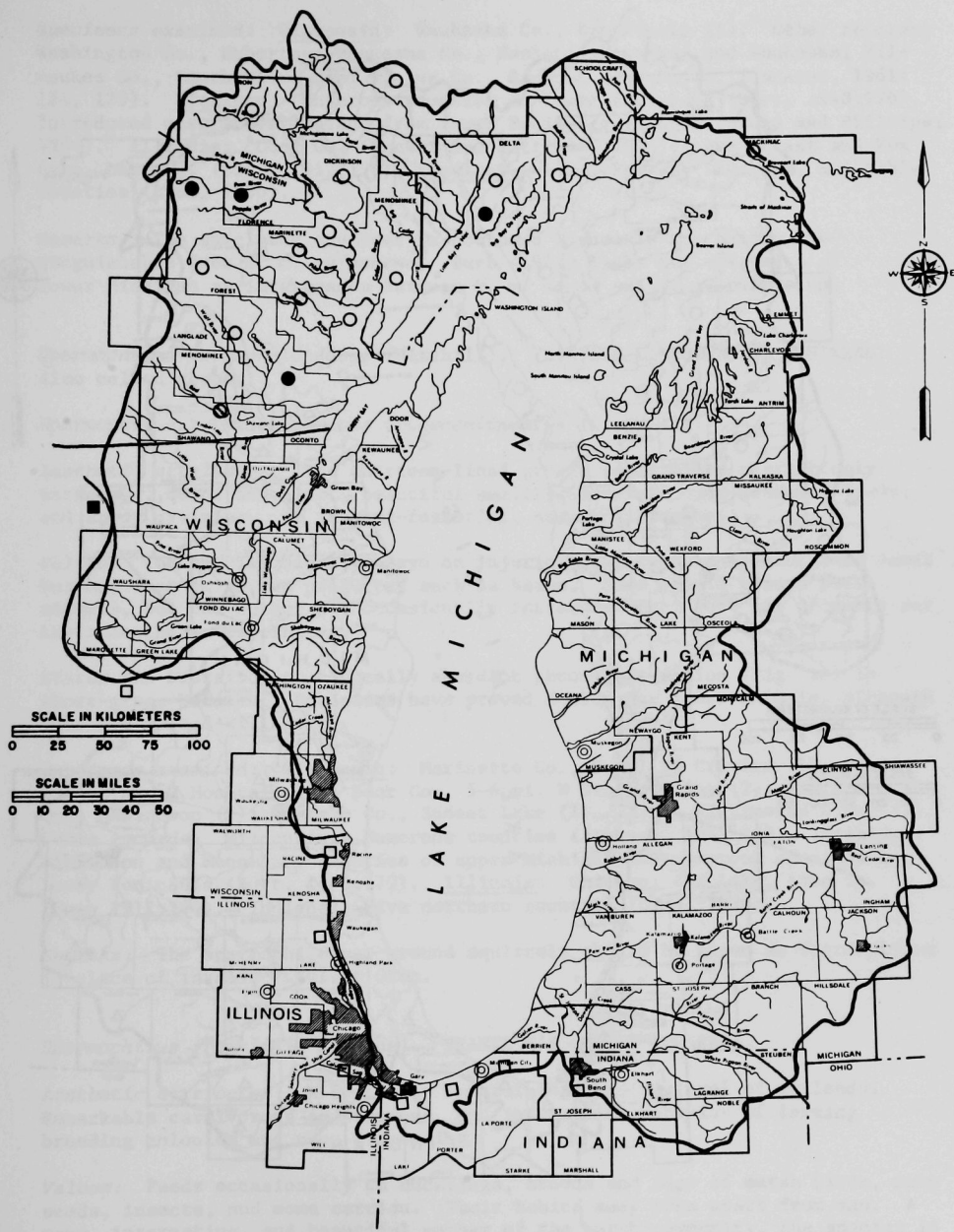


Fig. 16. Distribution of *Eutamias minimus* (circles) and *Spermophilus franklinii* (squares).

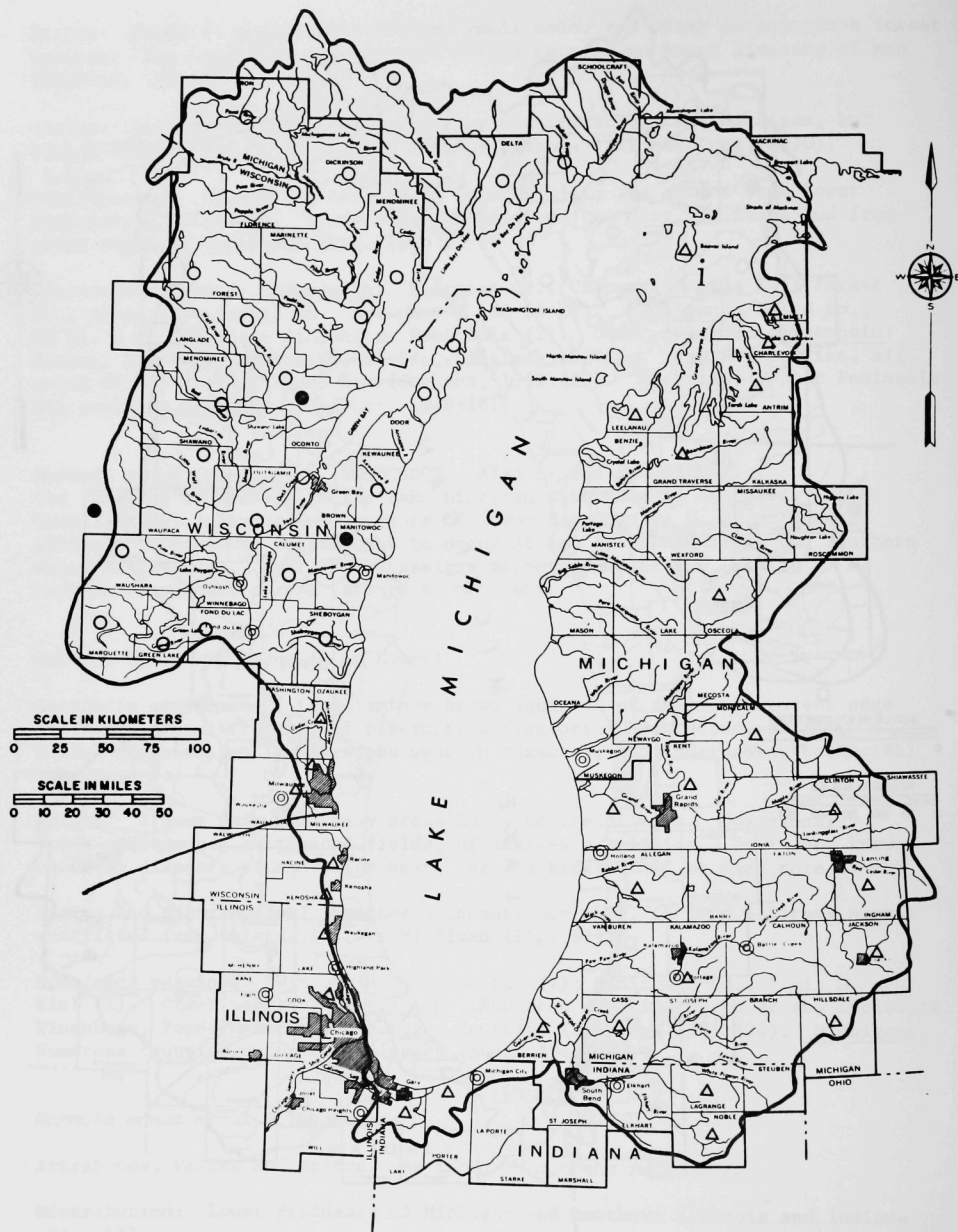


Fig. 17. Distribution of *Marmota monax*. *M. m. rufescens* (circles) and *M. m. monax* (triangles).

Specimens examined: Wisconsin: Waukesha Co., Brookfield (1). *Other records:* Washington Co., Hubertus; Waukesha Co., Nashota, Pewaukee and Waukesha; Milwaukee Co., South Milwaukee; Racine Co., Racine; Kenosha Co. (Jackson, 1961:124, 129). Michigan: Numerous counties on Lower Peninsula (Burt, 1948:176). Introduced onto Beaver Island from Lower Peninsula in 1955 (Ozoga and Phillips, 1964). Illinois: Cook Co. (Necker and Hatfield, 1941); Lake Forest and Fox Lake, Lake Co. (Cory, 1912:156). Indiana: Lake, Porter, LaGrange, and Noble counties (Lyon, 1936).

Remarks: The specimens examined in southern Wisconsin are hardly distinguishable from *M. m. rufescens*. Burt (1943) lists the specimens of lower Michigan as intergrades between *M. m. monax* and *M. m. rufescens*.

Spermophilus tridecemlineatus (Mitchill). THIRTEEN-LINED GROUND SQUIRREL. Also called gopher.

Spermophilus tridecemlineatus tridecemlineatus (Mitchill).

Aesthetic attributes: The thirteen-lined ground squirrel is a strikingly patterned, quick and alert, beautiful small squirrel of open meadows, lawns, and sandy prairies. It is semi-fossorial, and it hibernates.

Values: The species usually preys on injurious insects and harmful weed seeds but may feed on garden products, such as beans. Some people poison these animals, but the author has occasionally introduced them onto his property for their aesthetic attributes.

Status and Distribution: Locally abundant throughout region (Fig. 18) in short-grass habitat. Roadsides have proved a boon for these animals, although they pay a road-kill price.

Specimens examined: Wisconsin: Marinette Co., 9 mi. NW Crivitz (1); Oconto Co., 7 mi. W Mountain (1); Door Co., 5-6 mi. W Sturgeon Bay (2); Manitowoc Co., Manitowoc (1); Portage Co., Sunset Lake (1), 18 mi. NE Stevens Point (1). *Other records:* Wisconsin: Numerous counties (Jackson, 1961:132). Michigan: Dickinson and Menominee counties of upper Michigan and numerous counties on Lower Peninsula (Burt, 1948:179). Illinois: Chicago; Fox Lake, Lake Co. (Cory 1912:144). Indiana: Five northern counties (Lyon, 1936).

Remarks: The spermophiles or ground squirrels should be known as *Spermophilus* in place of invalid *Citellus* Oken.

Spermophilus franklini (Sabine). FRANKLIN'S GROUND SQUIRREL.

Aesthetic attributes: A typically beautiful ground squirrel of wetlands. Remarkable carnivorous adaptations, and interesting behavior of forming breeding colonies and then dispersing.

Values: Feeds occasionally on ducklings, broods and eggs of marsh birds, many seeds, insects, and some carrion. Their habits keep them apart from man. A rare, interesting, and beautiful member of the marsh community, the species is seldom harmful there.

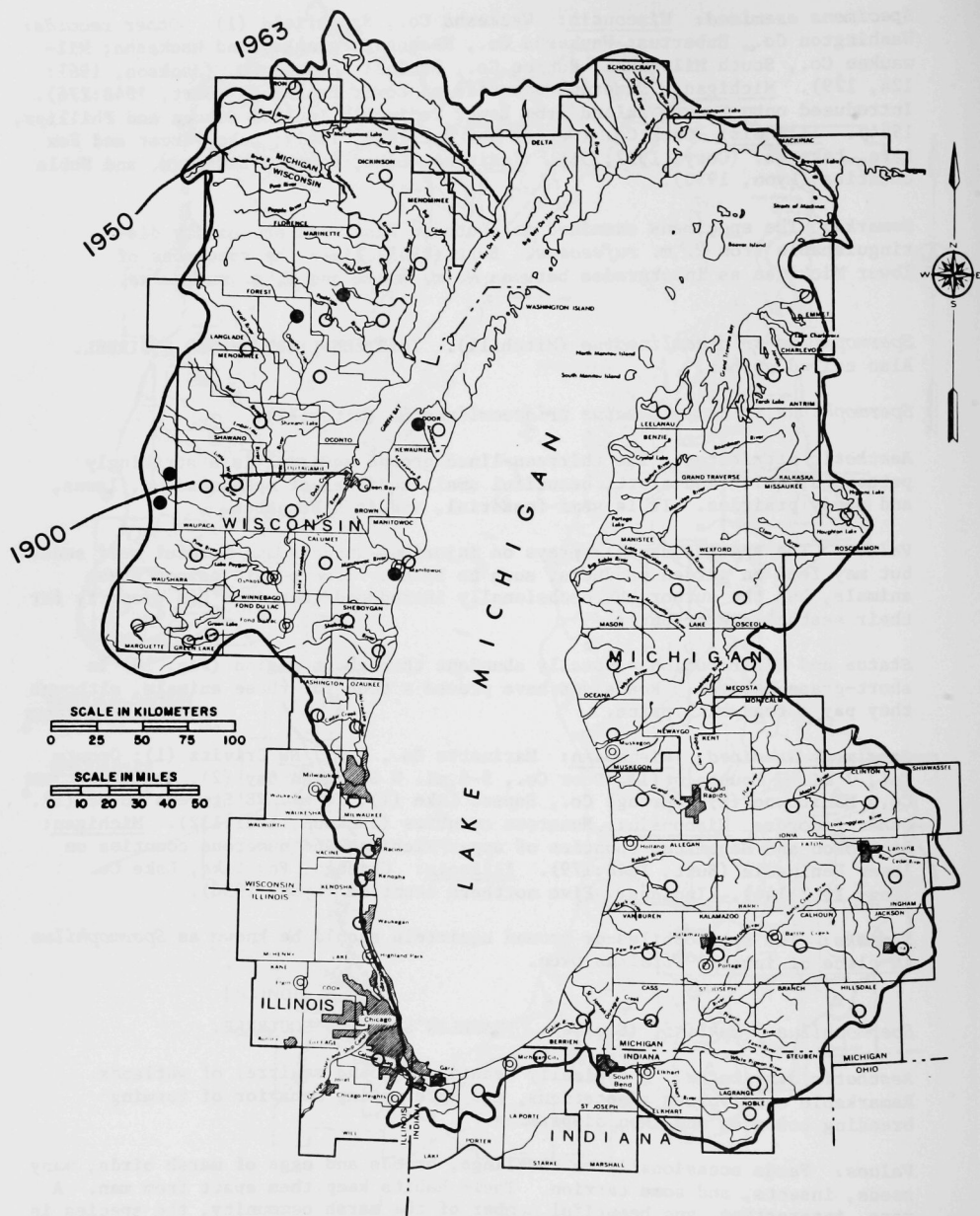


Fig. 18. Distribution of *Sperophilus tridecemlineatus*.

Status: Rare and local in occurrence. Should be listed as threatened in this region.

Distribution: Confined to southern and perhaps western counties (Fig. 16).

Specimens examined: None. **Other records:** Wisconsin: Racine Co., Racine (Jackson, 1961). Illinois: Cook and Lake counties (Necker and Hatfield, 1941). Indiana: Lake, Porter, Laporte, and St. Joseph counties (Lyon, 1936).

Tamiasciurus hudsonicus (Erxleben). RED SQUIRREL.

Tamiasciurus hudsonicus loquax (Bangs).

Aesthetic attributes: Only the red fox has such a bright red coat (suggesting a possible reason for the dominance of this diminutive squirrel in aggressively driving away *Sciurus carolinensis*). Extensive variation in seasonal color (depending on molt), the adaptations to both arboreal and semi-fossorial niches, the food middens (refuse) formed in the forests, the strong preference for coniferous habitat, and the aggressive nature, as well as their agility in the high pines, are remarkable.

Values: Red squirrels are prey of some forest predators, and was the chief prey of the pine marten. It has limited value to man as a fur or food animal. It plants seeds and nuts of forest trees. This squirrel feeds on seeds, nuts, insects, and seldom on broods of birds. Occasionally it becomes a nuisance in attics.

Status and Distribution: Fairly abundant in areas of conifers or mixed coniferous forest, the red squirrel has lost geographic range in the southern counties (Fig. 19). Extirpated in Illinois. Unknown on islands except Washington Island.

Remarks: Jackson (1961) regards the Wisconsin red squirrels as *Tamiasciurus hudsonicus minnesotae*, and Burt (1948) refers squirrels throughout Michigan to *T. h. loquax*.

Specimens examined: Wisconsin: Florence Co., 1 mi. N Long Lake (1); Forest Co., Alvin (3), Pickerel Lake (1); Marinette Co., 13 mi. N Marinette (1); Oconto Co., 2 mi. W Oconto Falls (1); Manitowoc Co., Two Rivers (1), Manitowoc (1); Portage Co., 15 mi. W Stevens Point, Tomorrow River (1); Sheboygan Co., N Kettle Moraine State Forest (2). **Other records:** Wisconsin: Numerous counties, Washington Island (Jackson, 1961:171). Michigan: Numerous counties on Upper and Lower Peninsulas (Burt, 1948:188). Illinois: Former records at Lake Forest and Fox Lake, Lake Co. (Cory, 1912:126). Indiana: Numerous counties (Lyon, 1936).

Sciurus niger Linnaeus. FOX SQUIRREL.

Sciurus niger rufiventer Geoffrey St. Hilaire.

Aesthetic attributes: Most people appreciate fox squirrels, except when they dominate a bird feeder. This squirrel's ochraceous color and huge fluffy tail

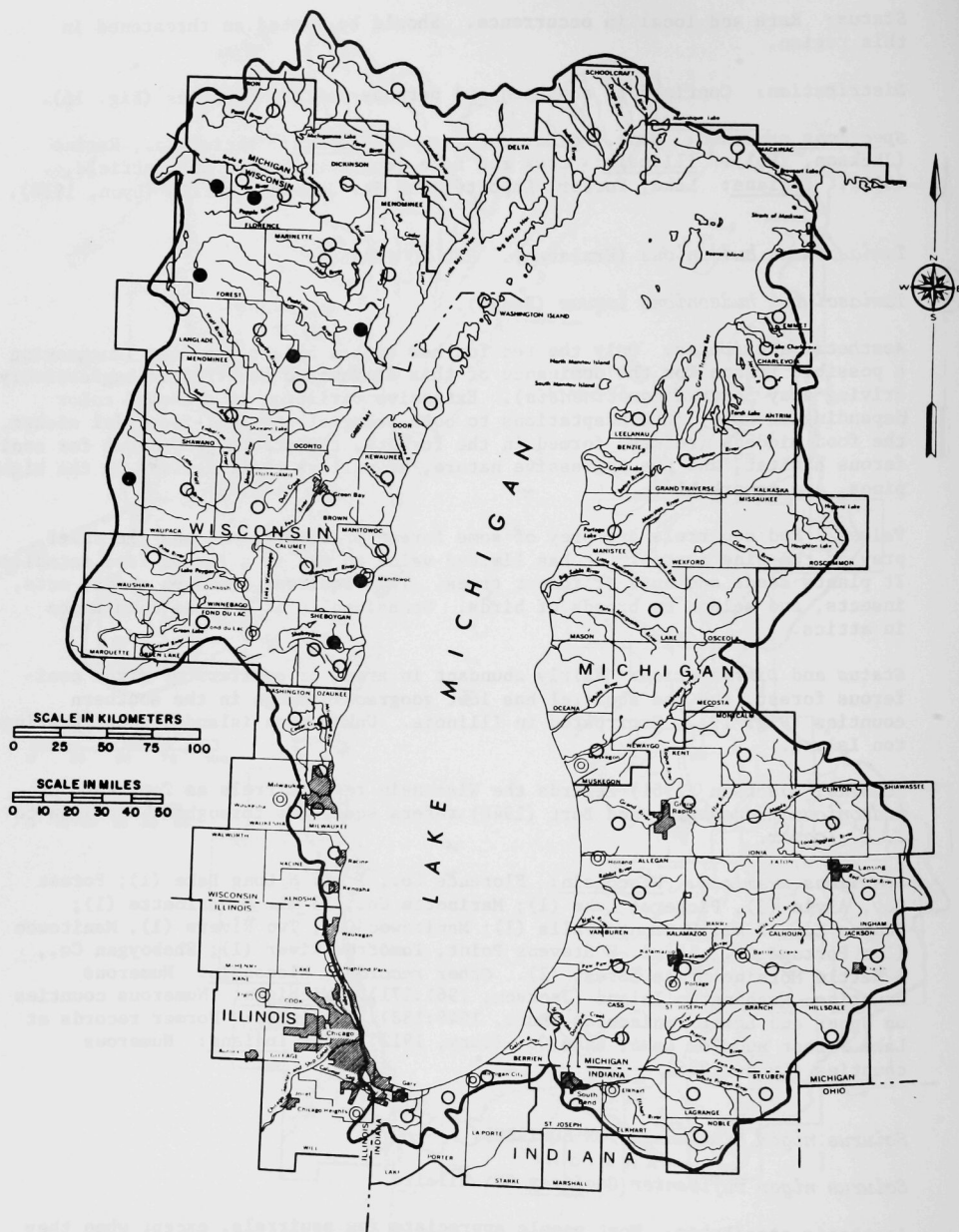


Fig. 19. Distribution of *Tamiasciurus hudsonicus*.

make it a beautiful member of the attractive squirrel family. The fox squirrel prefers open hardwoods, forest edges, and sunny woodlands, and tends to replace gray squirrels in such habitats. The scansorial habits, cacheing of food, and courtship, nesting, and care of young are remarkable.

Values: A fine game animal with excellent flesh. Deplorably, squirrel tails are often used as decorations. Fox squirrels seldom become nuisances in man's habitats.

Status: Spreading northward by man's altering of forest habitats, and by man's introductions.

Distribution: Ranges throughout the region (perhaps excepting some counties in upper Michigan) and has been introduced onto some islands in Lake Michigan (Fig. 20).

Specimens examined: Wisconsin: Manitowoc Co., 10 mi. NW Manitowoc (3), Manitowoc (1); Waukesha Co., no specific locality (1). **Other records:** Wisconsin: Numerous counties (Jackson, 1961:166 and McCabe, 1972). Michigan: Numerous counties on Lower Peninsula (Burt, 1943:194). Illinois: Cook Co. (Necker and Hatfield, 1941); Lake Co., Fox Lake and Lake Forest (Cory, 1912:113). Indiana: Numerous counties (Lyon, 1936).

Sciurus carolinensis Gmelin. GRAY SQUIRREL. Includes black squirrel.

Sciurus carolinensis hypophaeus Merriam.

Aesthetic attributes: The beautiful silvery gray squirrels have a high frequency of melanistic individuals, lending variety and added beauty to this species. The melanism, scansorial adaptations, prominent ear tufts in winter, mass emigration (rarely, see Cory, 1912) and other attributes of gray squirrels are interesting.

Values: A superior game animal having excellent flesh. This species feeds on seeds, nuts, and insects primarily, and by storing the seeds and nuts aids in planting trees. Occasionally a nuisance in houses and around bird feeders and gardens, the species is easily controlled (Jackson, 1961:164).

Status: Abundant.

Distribution: Upper Peninsula of Michigan, Beaver and High Islands (introduced), and Wisconsin (Fig. 20).

Specimens examined: Wisconsin: Forest Co., Pickerel Lake (1); Marinette Co., 9 mi. NW Crivitz (1); Waupaca Co., Waupaca (1); Sheboygan Co., N Kettle Moraine State Forest (1); Green Lake Co., no specific locality (1); Waukesha Co., no specific locality (1); Milwaukee Co., Milwaukee (2). **Other records:** Wisconsin: Numerous counties (Jackson 1961:158). Michigan: Numerous counties on Upper Peninsula and occurring on Beaver Island (Burt, 1948:191).

Remarks: Hall and Kelson (1959) mapped all squirrels in the Lake Michigan watershed as belonging to *Sciurus carolinensis pennsylvanicus*. However,

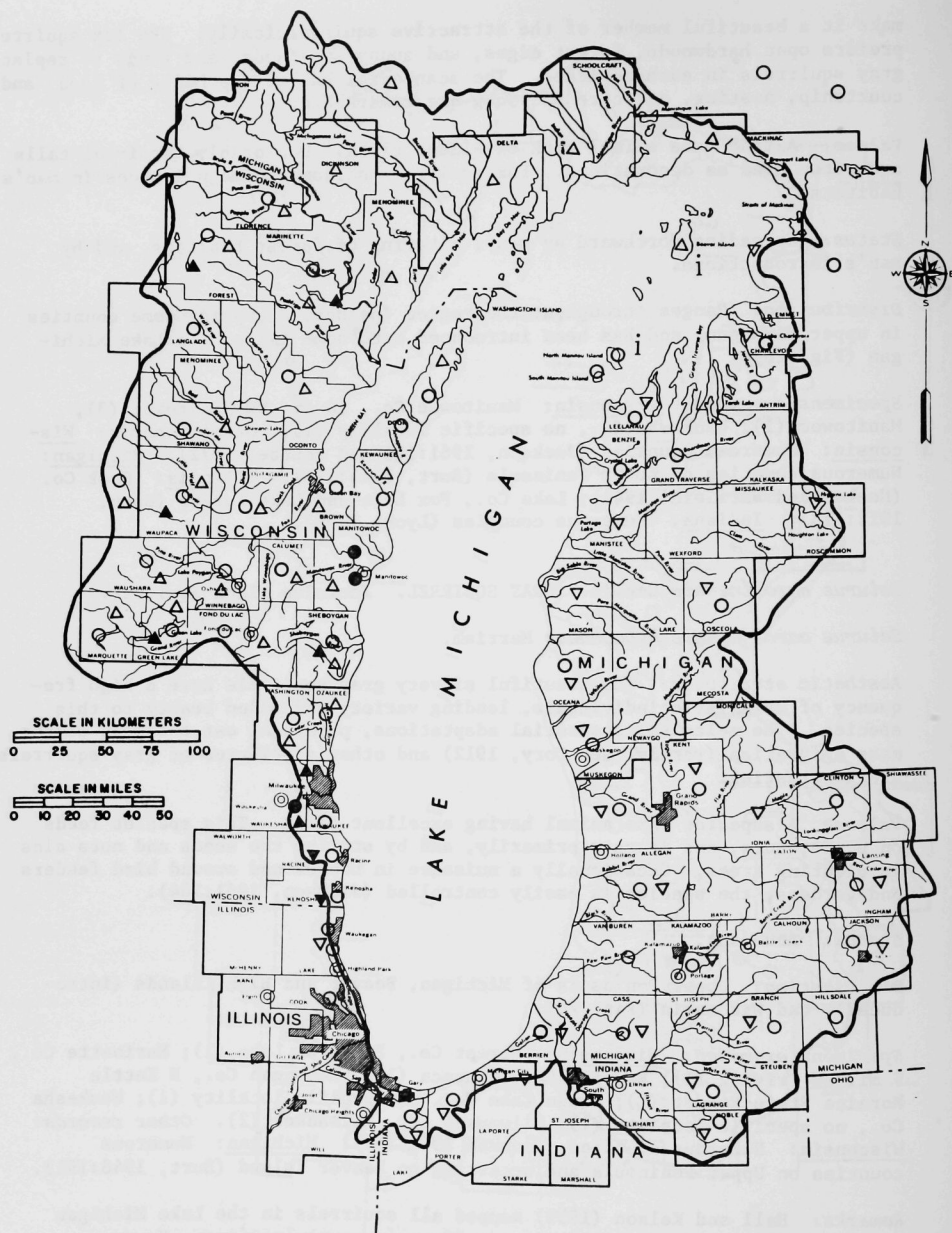


Fig. 20. Distribution of *Sciurus niger* (circles), *S. carolinensis hypophaeus* (triangles), and *S. c. pennsylvanicus* (inverted triangles).

Burt (1948), Jackson (1961), and Long (1970) refer specimens west of the lake to *S. c. hypophaeus*, a subspecies characterized chiefly by darker venter and ear tufts in winter. Possibly specimens in Milwaukee and Racine counties are referable to *S. c. pennsylvanicus*, but in Kenosha County the gray squirrels belong to *S. c. hypophaeus*.

Sciurus carolinensis pennsylvanicus Ord.

Aesthetic attributes, Values and Status: Similar to those of *S. c. hypophaeus*, although this subspecies lacks prominent ear tufts in winter.

Distribution: South shore of Lake Michigan and Lower Peninsula of Michigan (Fig. 20).

Remarks: Burt's (1948) trinomen *S. c. leucotis* Gapper is a synonym of *S. c. pennsylvanicus*.

Specimens examined: None. *Other records:* Michigan: Numerous counties on Lower Peninsula (Burt, 1948:191). Illinois: Lake Co., Lake Forest (Cory, 1912:122). Indiana: Numerous counties (Lyon, 1936).

Glaucomys volans (Linnaeus). SOUTHERN FLYING SQUIRREL.

Glaucomys volans volans (Linnaeus).

Aesthetic attributes: A softly-colored member of the attractive squirrel family. The enormous nocturnally adapted eyes provide it an appearance of innocence and beauty, the flattened tail (for gliding) is an artistic structure. The flying squirrels are the only "volant" mammals and nocturnal squirrels in North America. Their social behavior (occasional aggregations in houses or hollow trees in winter) and the overlap and competition for nest cavities (usually woodpecker cavities) between northern and southern species is interesting (Muul, 1968).

Values: Harmless to man except occasionally becoming a nuisance in attics. The species is prey for owls and other predators.

Status: Very abundant in southern counties, although seldom seen, advancing northward at the expense of *Glaucomys sabrinus*, which breeds later and cannot successfully compete with *G. v. volans* for nest cavities (Muul, 1968).

Distribution: Ranges generally throughout the region, although uncommon along the east shore of Lake Michigan and apparently absent on all islands (Fig. 21).

Specimens examined: Wisconsin: Oconto Co., Mountain (1), Green Lake, 10 mi. E Stevens Point (1), Heigs farm (1). *Other records:* Wisconsin: Marquette Co.; Fond du Lac Co.; Waukesha Co.; Milwaukee Co., Fox Point and Milwaukee; Racine Co. (Jackson, 1961:177, 180). Michigan: Menominee Co., Upper Peninsula and numerous counties south of and including Ottawa, Kent, Ionia, and Clinton counties of the Lower Peninsula (Burt, 1948). Illinois: Cook and Lake counties (Necker and Hatfield, 1941). Indiana: Lake, Laporte, St. Joseph and LaGrange counties (Lyon, 1936).

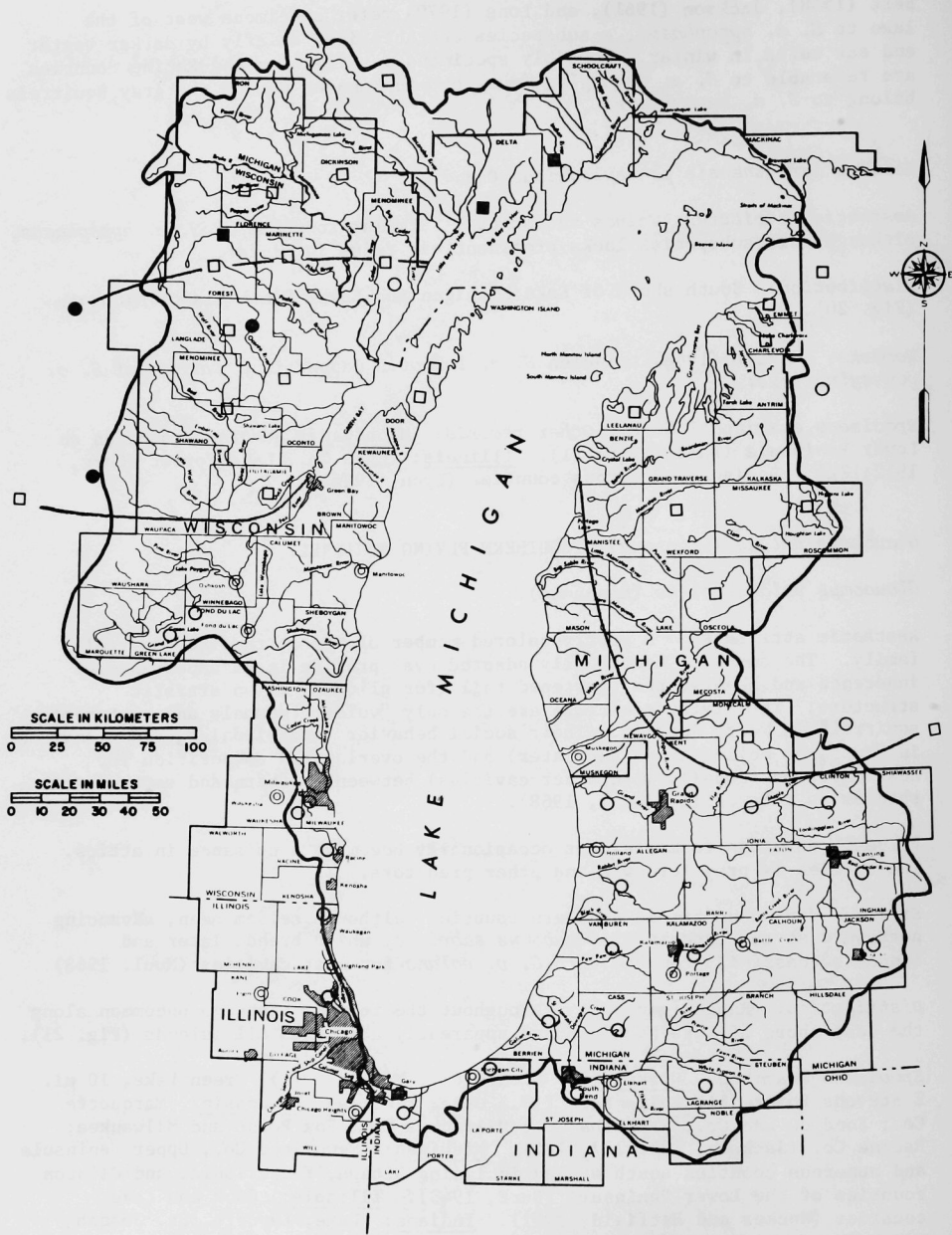


Fig. 21. Distribution of *Glaucomys volans* (circles) and *G. sabrinus* (squares).

Glaucomys sabrinus (Shaw). NORTHERN FLYING SQUIRREL.

Glaucomys sabrinus macrotis (Mearns).

Aesthetic attributes and Values: Similar to those of *Glaucomys volans*; occurs more often in conifers.

Status and Distribution: This species is rare and confined to northern counties, although ranging southward on the Lower Peninsula of Michigan. The species should be listed as threatened in Wisconsin, perhaps so in Michigan (Fig. 21).

Specimens examined: Wisconsin: Forest Co., Laona, Hwy 6 (1). Michigan: Schoolcraft Co., 4 mi. N Mystique (2); Delta Co., 15 mi. E Escanaba, on Stonington Peninsula (2). **Other records:** Wisconsin: Florence Co., Sea Lion Lake and Lost Lake (McCabe, 1972). Forest Co.; Marinette Co., Coleman Lake Club; Oconto Co., Kelly Brook; Door Co., Clarks Lake and Fish Creek; Outagamie Co., Oneida (Jackson, 1961:182, 184). Michigan: Numerous counties on Upper Peninsula, and northern counties on Lower Peninsula, including also the more southern Wexford, Osceola and Montcalm counties (Burt, 1948:199).

CASTORIDAE - BEAVERS

Castor canadensis Kuhl. BEAVER. Also called bank beaver.

Castor canadensis michiganensis Bailey.

Aesthetic attributes: Beautiful fur. Possesses remarkable adaptations for aquatic life. Has incredible engineering capacities for building dams, lodges, canals, bank burrows, and can fell (by gnawing) a large tree in one night. Feeds on bark and cambium, particularly that of seral trees such as aspen and willow.

Values: This species was one of the most important animals in America, providing lucrative fur resources until it was nearly exterminated. The flesh is highly edible, even the tail (soup). Beavers damage stream banks, cut down many trees (aspen, willow, little value, occasionally fruit trees) and dam tiny trout brooks forming beaver ponds (sometimes quite compatible to large trout). Beaver ponds conserve water in the headwater regions. The anal glands have been used to manufacture perfume. Nuisance beavers can be transplanted to wilderness areas provided the state authorities care to do so.

Status: Improved since near extinction about 1900, but declining in numbers and losing habitat in the western half of the Lake Michigan region (Knudsen, 1953). The species is threatened there and is carefully managed.

Distribution: Formerly throughout the region but now absent from the southern and urban areas (not mapped).

Remarks: Jackson (1961) assigned all beaver in Wisconsin to *Castor canadensis michiganensis* without comment, although other workers referred these animals to *C. c. canadensis* without comment. The provisional and casual assignments to subspecies warrant a taxonomic appraisal of beaver in the Great Lakes region.

Specimens examined: None. *Other records:* Wisconsin: Numerous counties north of and including Sheboygan and Fond du Lac counties (Jackson, 1961:194). Michigan: Numerous counties on Upper and Lower Peninsulas (Burt 1948:202) and Beaver Island (possibly exterminated by 1853, reestablished in 1932) (Ozoga and Phillips, 1964). Illinois: Cook Co. (Cory, 1912:162). Indiana: Lake, Porter, LaPorte, St. Joseph, LaGrange, and Steuben counties (Lyon, 1936).

CRICETIDAE - NEW WORLD RATS AND MICE

CRICETINAE

Peromyscus maniculatus (Wagner). DEER MOUSE.

Although taxonomically assigned to one species, deer mice in the Lake Michigan region belong to two distinctive geographic races (Hooper, 1942). Morphologically dissimilar and adapted to entirely different kinds of habitats, the deer mice interact as two species. Intergradation does not occur between these two races, but each of them intergrades with other races of deer mouse. The species is, therefore, a complex Rassenkreis (polytypic species), and one of its overlapping species is in the Lake Michigan region, on either side of the lake (Hooper, 1942; Jackson, 1961; Dice, 1952). The larger, boreal kind has recently come into contact with the invading smaller, southern kind.

Peromyscus maniculatus bairdii (Hoy and Kennicott). PRAIRIE DEER MOUSE.

Aesthetic attributes: A small, short-tailed, clean-looking mouse, which maintains both home range and territory. The species is a good indicator of prairie grassland.

Values: Although the species is definitely a mammal of prairie grassland, it feeds primarily on seeds of wild plants and seldom damages crops. Foxes, coyotes, skunks, marsh hawks, kestrels, long- and short-eared owls as well as other owls, weasels, large snakes, and probably shrews prey on this valuable "forage" species.

Status: Abundant in prairie, sandy brushy areas, hayfields, and other grasslands, even mown cultivated fields. Jackson (1961:214) suggests the species is expanding its geographic range northward in Wisconsin. In Michigan it now occurs throughout the Lower Peninsula, whereas it was originally restricted south of the northeastern hardwood forests (Hooper, 1942).

Distribution: Occurs (Fig. 22) in dry, grassy habitats throughout the Lake Michigan drainage as far north as Menominee Co., Michigan, on the west shore, and apparently confined within the Lake Michigan watershed in the northern half of the Lower Peninsula (Burt, 1948:206). The species apparently is not present on any island in the lake, excepting a doubtful but possibly accurate record from Fisherman's Island.

Specimens examined: Wisconsin: Waupaca Co., 1/2 mi. E Waupaca (1); Kenosha Co., 5 mi. W Kenosha (9). *Other records:* Wisconsin: Milwaukee, Racine, Kenosha, Oconto, Door and Brown counties (Jackson, 1961:214-215). Michigan: Numerous counties on Lower Peninsula, but confined to the Lake Michigan watershed in northern counties (Burt, 1948:206). Illinois: Cook Co. (Necker and Hatfield, 1941); Lake Co., Fox Lake (Cory, 1912:193). Indiana: Porter and St. Joseph counties (Lyon, 1936).

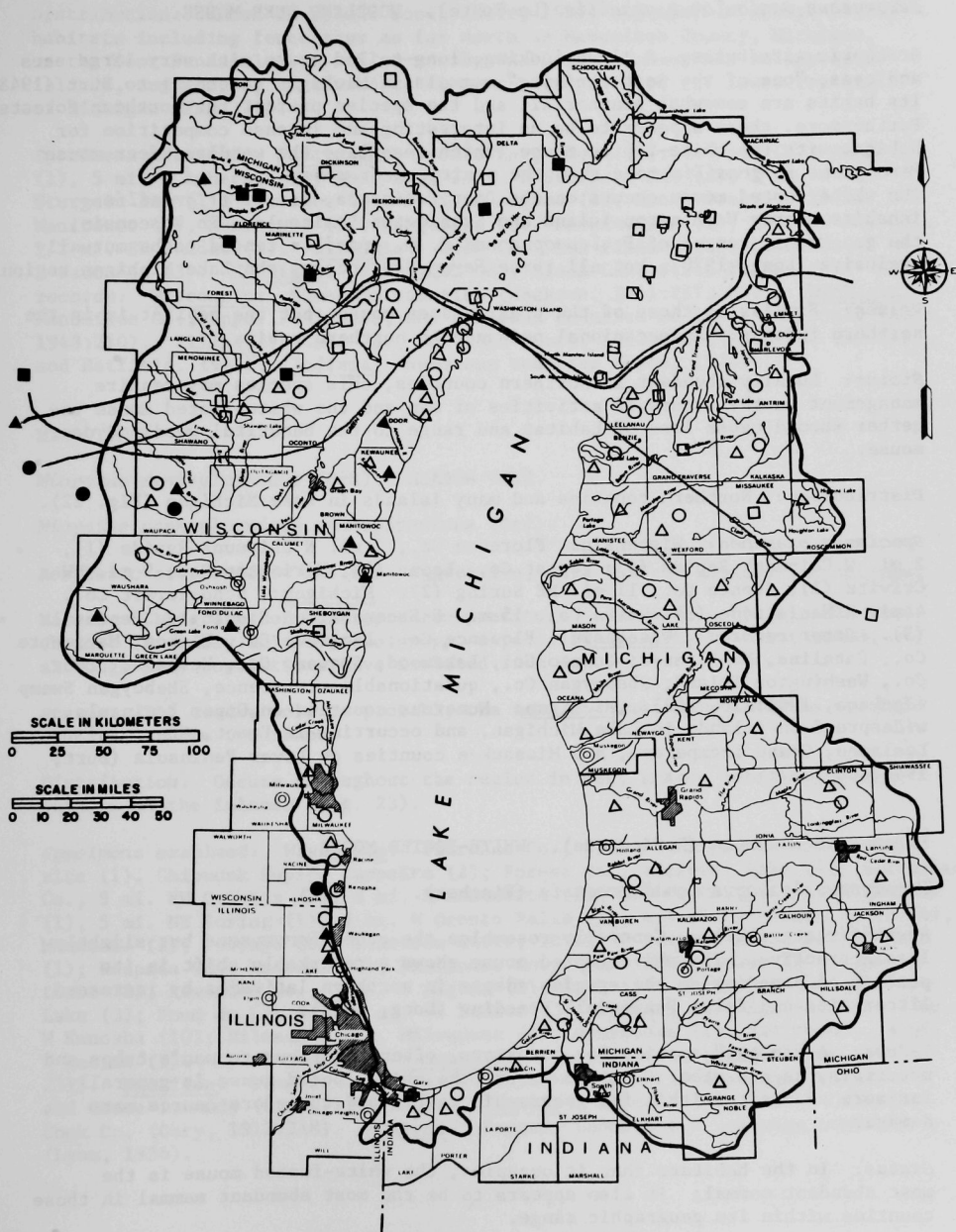


Fig. 22. Distribution of *Peromyscus maniculatus gracilis* (squares), *P. m. bairdii* (circles), and *P. leucopus* (triangles).

Peromyscus maniculatus gracilis (Le Conte). WOODLAND DEER MOUSE.

Aesthetic attributes: A clean-looking, long-tailed mouse with very large ears and eyes, "one of the most striking" mammals in Michigan according to Burt (1948). Its habits are somewhat scansorial, and the species prefers the northern forests. Furthermore, there appears to be an interesting and intense competition for habitat with the white-footed mouse (which resembles the woodland deer mouse *Peromyscus m. gracilis* more than the prairie deer mouse).

The white-footed mouse occurs on the Door Peninsula, but *P. m. gracilis* inhabits nearby Washington Island and Stonington Peninsula. In Wisconsin, the geographic ranges of *P. leucopus* and *P. m. gracilis* tended to be mutually exclusive (Long, 1970), but all three *Peromyscus* occupy the Lake Michigan region.

Values: Similar to those of the prairie deer mouse, but the habitat is in the northern forests. An occasional nuisance in northern cabins.

Status: Locally abundant in northern counties, this species may require management in the future if activities of man and the white-footed mouse together should cause loss of habitat and range to the beautiful woodland deer mouse.

Distribution: Northern counties and many islands in Lake Michigan (Fig. 22).

Specimens examined: Wisconsin: Florence Co., 2 mi. N Chipmunk Rapids (1), 2 mi. W Chipmunk Rapids (8); Forest Co., Laona (2); Marinette Co., 9 mi. NW Crivitz (1); Oconto Co., 11 mi. NE Suring (2). Michigan: Schoolcraft Co., 4 mi. N Manistique (3); Delta Co., 15 mi. E Escanaba, on Stonington Peninsula (3). *Other records:* Wisconsin: Florence Co.; Langlade Co., Elchoe; Marinette Co., Cataline, McAllister; Oconto Co., Lakewood; Shawano Co., Keshena; Door Co., Washington Island; Sheboygan Co., questionable occurrence, Sheboygan Swamp (Jackson, 1961:210, 212). Michigan: Numerous counties on Upper Peninsula, widespread on islands in Lake Michigan, and occurring in Emmet, Charlevoix, Leelanau, Grand Trempeleau, and Missaukee counties on Lower Peninsula (Burt, 1948:206).

Peromyscus leucopus (Rafinesque). WHITE-FOOTED MOUSE.

Peromyscus leucopus noveboracensis (Fischer).

Aesthetic attributes: Generally resembles the other *Peromyscus* but slightly less attractive. The white-footed mouse shows a remarkable shift in its pattern of breeding as the species adapts in northern latitudes by increased litter size and false "unimodal" breeding (Long, 1973).

Values: A "forage" species for predators, often injurious to man's crops and materials, as are other *Peromyscus*, but the white-footed mouse is generally far more abundant (within its geographic range) and therefore causes more damage.

Status: In the habitats that it occupies, the white-footed mouse is the most abundant mammal; it also appears to be the most abundant mammal in those counties within its geographic range.

Distribution: Known in upland woods (Getz, 1959) and also in sandy, brushy habitats including fence rows as far north as Menominee County, Michigan, on the Door Peninsula but not on nearby Washington Island nor on any other islands, and ranging northward to the northern parts of the Lower Peninsula of Michigan (Fig. 22).

Specimens examined: Wisconsin: Forest Co., Alvin (1); Waupaca Co., Amherst (1), 5 mi. W Amherst (1); Door Co., 3 mi. E Sturgeon Bay (2), 5 mi. W Sturgeon Bay (1); Kewaunee Co., 2 mi. N Algoma (2); Manitowoc Co., 15 mi. NW Manitowoc (1), Manitowoc (1); Marquette Co., Harrisville (1); Fond du Lac Co., 1/2 mi. SE Dundee (1). Illinois: Cook Co., Des Plaines (6); Lake Co., 2 mi. S Wauconda (3). Michigan: Sheboygan Co., Black Lake State Forest (2). *Other records:* Wisconsin: Numerous counties (Jackson, 1961:217, 219). Michigan: Menominee Co., Upper Peninsula, and numerous counties on Lower Peninsula (Burt, 1948:210). Illinois: Lake Co., Fox Lake (Cory, 1912:188); Cook Co. (Necker and Hatfield, 1941). Indiana: Numerous counties (Lyon, 1936).

MICROTINAE

Microtus pennsylvanicus (Ord). MEADOW VOLE.

Microtus pennsylvanicus pennsylvanicus (Ord).

Aesthetic attributes: A large, aggressive, dark vole of meadows and marshes.

Values: Chief prey of most northern predators, a very valuable link in food chains. Probably injurious to crops, especially damaging to fruit trees, although many populations live isolated from man.

Status: The meadow vole is probably the most abundant mammal in the northern counties of the watershed.

Distribution: Occurs throughout the region in wet, grassy habitats except perhaps on the islands (Fig. 23).

Specimens examined: Wisconsin: Florence Co., 2 mi. W Chipmunk Rapids Campsite (1), Chipmunk Rapids Campsite (2); Forest Co., Pickerel Lake (1); Marinette Co., 9 mi. NW Crivitz (1); 8 mi. N Marinette (1); Oconto Co., 11 mi. NE Suring (1), 5 mi. NE Suring (1), 3 mi. W Oconto Falls (1), 4.5 mi. W Oconto Falls (4), Mountain (1); Portage Co., Tomorrow River, 10 mi. E Stevens Point Heig's farm (1); Waupaca Co., Waupaca (2); Manitowoc Co., 1 mi. N Manitowoc (1), Manitowoc (8); Kewaunee Co., 2 mi. N Algoma (1); Kiel (1); Sheboygan Co., Random Lake (3); Fond du Lac Co., 2 mi. SE Dundee (3), Brandon (1); Kenosha Co., 5 mi. W Kenosha (10); Milwaukee Co., Milwaukee (1), Wauwatosa (1); Racine Co., 5 mi. W Racine (1). *Other records:* Wisconsin: Numerous counties (Jackson, 1961: 231). Michigan: Numerous counties on Upper and Lower Peninsulas, Marion and Goose islands (Burt, 1948:219). Illinois: Lake Co., Fox Lake; Chicago, Cook Co. (Cory, 1912:218). Indiana: Porter, Laporte and LaGrange counties (Lyon, 1936).

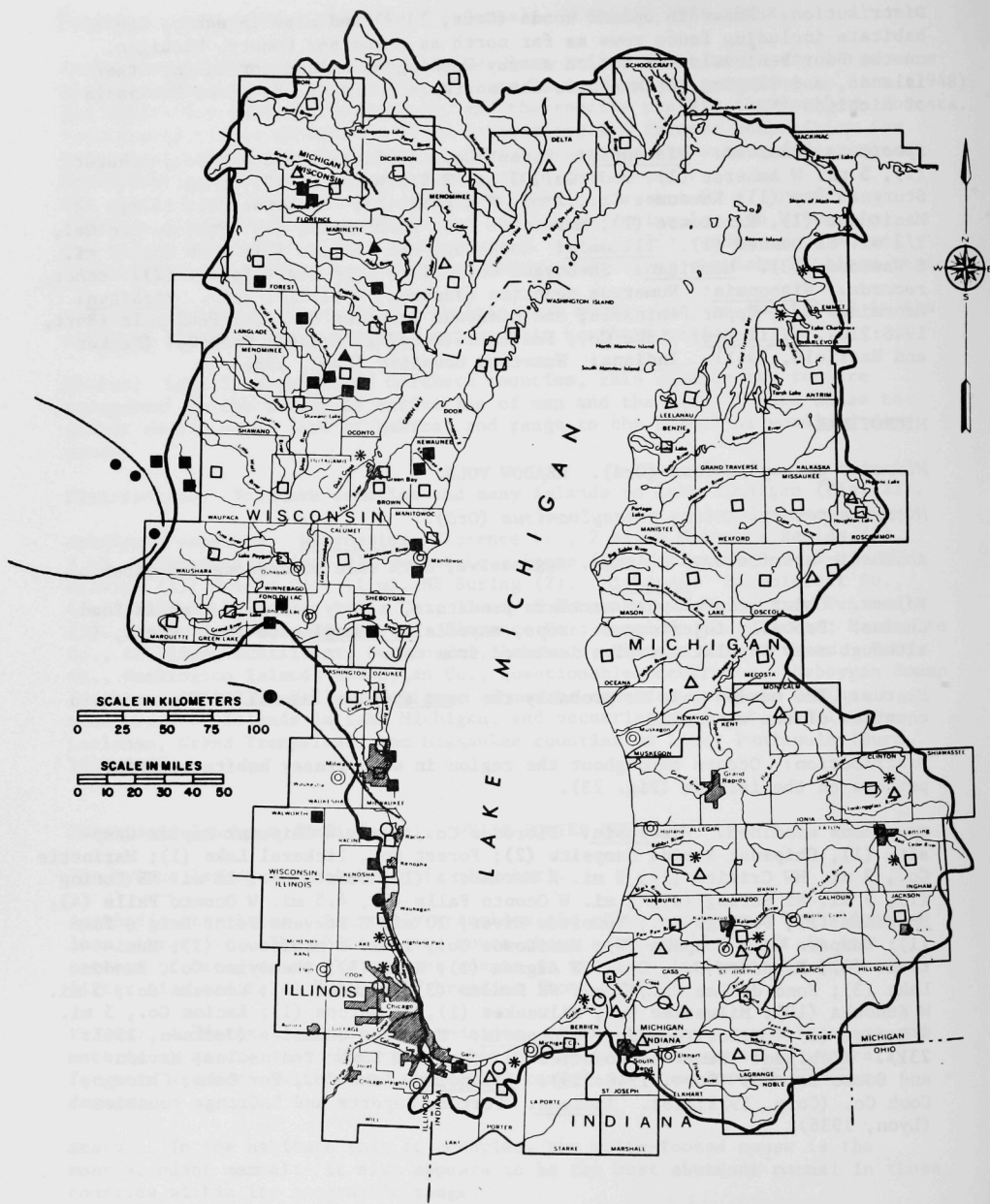


Fig. 23. Distribution of *Synaptomys cooperi* (triangles), *Microtus ochrogaster* (circles), *M. pennsylvanicus* (squares), and *Pitymys pinetorum* (asterisks).

Microtus ochrogaster (Wagner). PRAIRIE VOLE.

Microtus ochrogaster ochrogaster (Wagner).

Aesthetic attributes: A brownish, ochraceous pelage, paler than in other field mice. The distinct runways built in prairies and old fields are interesting for nature study.

Values: This species is locally abundant but generally rare, and seldom causes damage to crops. Its colonies are established in well-drained sparse prairie, meadows, and clover and alfalfa fields. It has also been noted in railroad rights-of-way and upland prairies, where no damage to crops or orchards was possible. The species is important in prairie food chains, doubtlessly providing flesh for carnivores such as foxes, skunks, badgers, marsh hawks, fox snakes, and short-eared owls. The rare least weasel feeds on prairie voles (Jackson, 1961:239).

Status and Distribution: Invades the Lake Michigan drainage region from the southern prairies, and is confined to dry prairies of southern counties (Fig. 23). A diminutive race or species of prairie voles occurs westward of the Lake Michigan region, but is as yet unknown in the watershed. This vole is being studied taxonomically.

Specimens examined: Wisconsin: None. Illinois: Lake Co., Fox Lake (3) Field Museum. **Other records:** Wisconsin: Racine Co., Racine (Jackson, 1961:237). Michigan: Known in Berrien and Cass counties, extreme southwestern part of Lower Peninsula (Burt, 1948:221). Roscommon Co., Sect. 16, Twp 24 N, R 4 W (Ozoga and Gaertner, 1963). Illinois: Cook Co. (Necker and Hatfield, 1941). Indiana: Porter, Laporte, and St. Joseph counties (Lyon, 1936).

Synaptomys cooperi Baird. SOUTHERN BOG LEMMING.

Aesthetic attributes: This vole is a grizzled, short-tailed, and less fossorial version of the pine vole, and is nearly as rare and local in occurrence. Its preferences are for sterile and dry red pine plantations and mesic maple-conifer forest floor (strewn with boulders). Contrary to its name, it is infrequently found in bogs. The waif-like, mysterious sporadic occurrences and just as mysterious disappearances of this vole have puzzled mammalogists in many states, suggesting extreme cyclic population fluctuations or incredible dispersal adaptations or both.

Values: Causes no significant damage to crops or trees, feeds primarily on grasses, and serves as prey to numerous predators.

Status: Although local in occurrence, preferring wooded areas where grasses are available (Getz 1961b), the species is often abundant, and just as often becomes rare or may disappear altogether. There are few specimens preserved, and the species may be considered threatened, and likely reduced greatly in numbers, although it ranges throughout the Lake Michigan region.

Distribution: Fig. 23.

Specimens examined: Wisconsin: Marinette Co., 9 mi. NW Crivitz, on Co. A (4); Oconto Co., 11 mi. NE Suring (1). *Other records:* Wisconsin: Florence Co., Lost Lakes (McCabe, 1972). Oconto Co., Lakewood and Kelly Lake; Shawano Co., Keshena; Sheboygan Co., Elkhart Lake (Sheboygan Swamp) (Jackson, 1961:24). Michigan: Marquette, Delta, and Menominee counties on the Upper Peninsula, and numerous counties on the Lower Peninsula (Burt, 1948:213). Indiana: Porter, St. Joseph, and LaGrange counties (Lyon, 1936).

Pitymys pinetorum (Le Conte). Known to some workers as *Microtus pinetorum*. PINE VOLE. Also known as woodland vole.

Pitymys pinetorum schmidtii Jackson.

Aesthetic attributes: Velvety, chestnut pelage characterizes this mouse which, by reason of large head, stout, tiny body and short tail, exemplifies natural "cuteness". The habits of this fossorial vole are truly remarkable, for it digs tunnels and runways only in deep leaf litter of dry deciduous forests (maple, hickory). Possibly relict populations from a warmer age (xerothermic period) the pine vole is seldom taken in pines and apparently does not stray from its runways and diggings.

Values: This threatened species is so rare and locally distributed that it probably makes little effect upon the environment. In its unique environment (for voles) it probably feeds on grasses, roots, and seeds, and is preyed upon by forest carnivores. In other states this vole damages fruit trees.

Status: Rare in Wisconsin and uncommon in other areas, local in distribution.

Distribution: One unspecific locality at Baird's Creek, Brown County, Wisconsin (specimen dropped by an owl). Fig. 23.

Specimens examined: None. *Other records:* Wisconsin: Brown Co., Bairds Creek (Jackson, 1961:245).

Remarks: The resemblance of *Pitymys* and *Microtus ochrogaster* has been noted (Hall and Nelson, 1959). The important divergence in unique characters of mole-like fur and fossorial behavior could be recognized by retaining the generic name *Pitymys* (Long, 1970). The equal divergence of *Pedomys* from *Microtus* led Jackson (1961) to assign *Pedomys* and *Pitymys* both to *Microtus*. Possibly the closely resembling *Pedomys* and *Pitymys* might be separated as a genus *Pitymys* McMurtrie, 1931. In any event, I choose to retain the name *Pitymys* for this fossorial species.

Pitymys pinetorum scalopsoides (Audubon and Bachman).

Burt (1948) and Necker and Hatfield (1941) use the trinomen *Pitymys pinetorum scalopsoides* for pine voles in lower Michigan and northern Illinois.

Aesthetic attributes, Values and Status: As in *Pitymys pinetorum schmidtii*.

Specimens examined: None. *Other records:* Lower Michigan: Emmet and Charlevoix (northern) and Allegan, Clinton, Ingham, Kalamazoo, and Berrien

(southern) counties of Lower Michigan (Burt, 1948:224). Illinois: Cook and Lake counties (Necker and Hatfield, 1941). Indiana: Porter, and St. Joseph counties (Lyon, 1936).

Clethrionomys gapperi (Vigors). RED-BACKED VOLE.

Clethrionomys gapperi gapperi (Vigors).

Aesthetic attributes: Rufous or rusty pelage and diminutive size characterize the common vole of coniferous swamps and forests. Its niche is unusual, for voles are generally grass eaters, and dwell in meadows and prairies.

Values: Its habitat precludes injury to man, and the vole feeds on some injurious insects (beetles, lepidopteran larvae) as well as other invertebrates, and especially fruits and seeds. As are other voles, *Clethrionomys* is common prey of numerous forest predators.

Status: Abundant in suitable habitat which contains conifers and other forest trees, often sparsely, as in marshes, but prefers habitats containing many dead-fall logs and stumps.

Distribution: Occurs primarily in northern counties, usually in conifers, such as tamarack swamps (Fig. 24). Not known from many islands, but found on Washington Island.

Specimens examined: Wisconsin: Florence Co., 2 mi. W Chipmunk Rapids (1); Forest Co., Pickerel Lake (1), Alvin (1), Crandon (1); Marinette Co., 9 mi. NW Crivitz (1); Oconto Co., 11 mi. NE Suring (1), Mountain (1); Portage Co., 15 mi. E Stevens Point (6); Ozaukee Co., Cederburg Bog (1); Marquette Co., Harrisville (1). Michigan: Delta Co., 15 mi. E Escanaba, Stonington Peninsula (1). **Other records:** Wisconsin: Numerous counties as far south as Milwaukee Co., Oak Creek (Jackson, 1961:226). Michigan: Numerous counties on the Upper Peninsula, and northern counties (Emmet and Leelanau counties) on the Lower Peninsula (Burt, 1948:215), Beaver Island (Ozoga and Phillips, 1964).

Ondatra zibethicus (Linnaeus). MUSKRAT.

Ondatra zibethicus zibethicus (Linnaeus).

Aesthetic attributes: Beautiful fur and notable aquatic behavior characterize this mammal. Air holes and food caches, as well as the high mud houses, provide noteworthy finds on a winter walk in an icy marsh.

Values: The most important furbearer in the world, and in the Lake Michigan region. The muskrat could be used as a source of food. This species feeds chiefly on aquatic and marsh plants (cattail, bulrush, etc.), and feeds to some extent on clams, snails, and crayfish. Its burrows in stream banks contribute to erosion. Tularemia might be contracted from muskrats. Generally, muskrats are harmless, useful components of the wetlands ecosystem.

Status: Fairly abundant in wetlands, ponds, and rather large bodies of water.

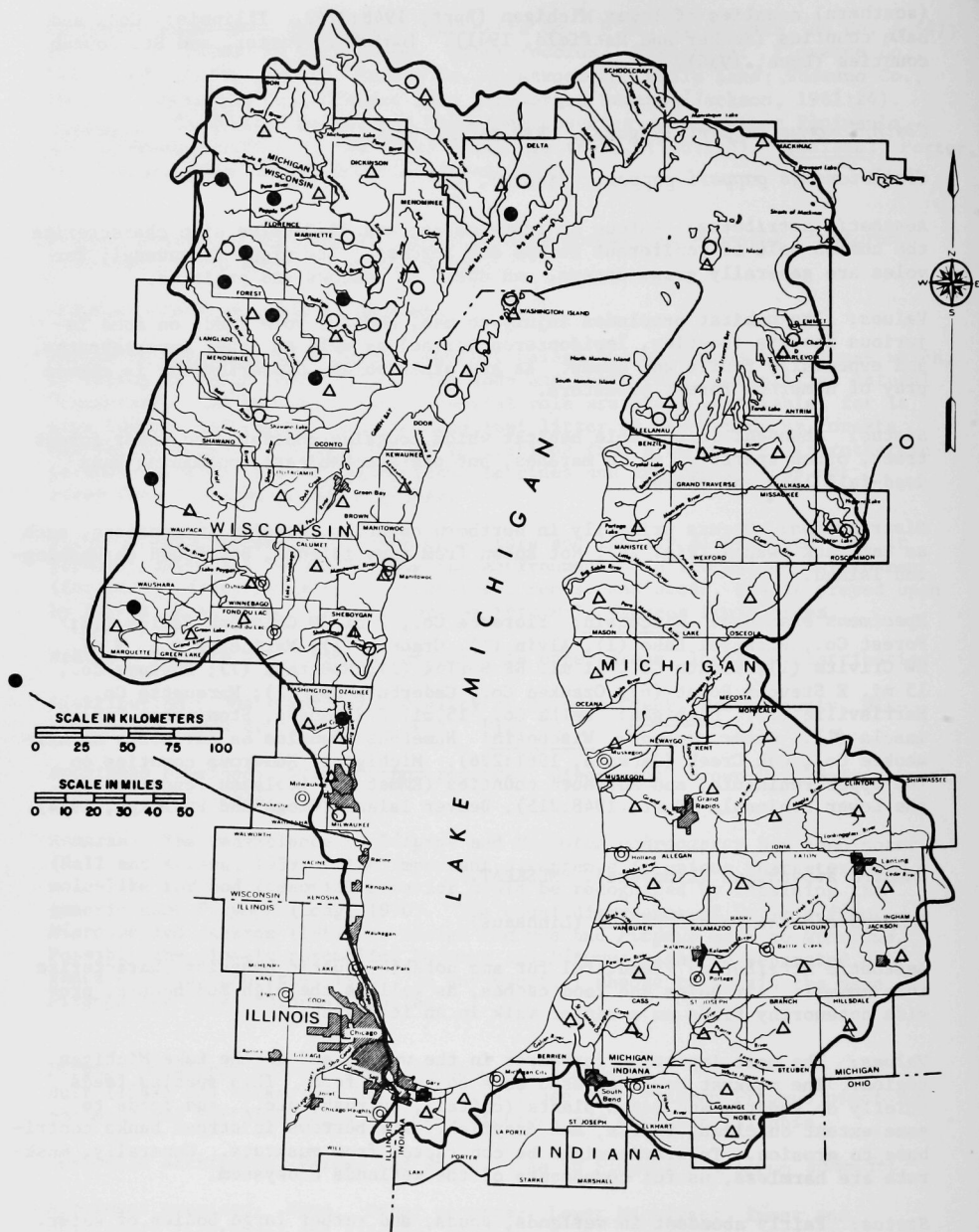


Fig. 24. Distribution of *Ondatra zibethicus* (triangles) and *Clethrionomys gapperi* (circles).

Distribution: Occurs throughout the Lake Michigan region (Fig. 24).

Specimens examined: Wisconsin: Forest Co., 2 3/4 mi. NW Crandon (1), Crandon (1); Marinette Co., 12 mi. NW Crivitz (1); Door Co., Sturgeon Bay (1); Manitowoc Co., Manitowoc (1); Kenosha Co., Hwy 50 and C, (1); Milwaukee Co. (1); Racine Co. (1). *Other records:* Wisconsin: Numerous counties (Jackson, 1961:247). Michigan: Numerous counties of Upper and Lower Peninsulas and Beaver Island (Burt, 1948:227). Illinois: Chicago (Cory, 1912:231). Indiana: Numerous counties (Lyon, 1936).

MURIDAE (or MURINAE) - OLD WORLD RATS AND MICE

Rattus norvegicus (Berkenhout). NORWAY RAT.

Aesthetic attributes and Values: Injurious to man, but domestic albino rats are valuable in bio-medical research, and some are eaten by owls, badgers, etc. The rat is harmful in his habitations, warehouses, or fields. In addition to destroying materials and food, rats are vectors for the following diseases of man: leprosy, typhus, paratyphoid glanders, spotted fever, cholera, tuberculosis, tularemia, dysentery, foot and mouth disease, rabies, rat-bite fever, Haverhill fever, epidemic jaundice, trichinosis, and mange (Jackson, 1961:257).

Status: This introduced pest is abundant in southern counties in man's habitations and occasionally, at least in summer, in the fields. Less common in northern counties. Sparse records result from selective trapping for wild mammals, not from rarity.

Distribution: Throughout Lake Michigan region (not mapped).

Specimens examined: Wisconsin: Marinette Co., Coleman (1); Ozaukee Co., Cedarburg Bog (1); Milwaukee Co., Currie Park (1). *Other records:* Wisconsin: Numerous counties (McCabe, 1972 and Jackson, 1961:254). Michigan: Scattered records in counties on Upper and Lower Peninsulas (Burt, 1948). Illinois: Chicago, Cook Co., Lake Co., Fox Lake (Cory 1912:181). Indiana: Porter and St. Joseph counties (Lyon, 1936).

Mus musculus Linnaeus. HOUSE MOUSE.

Mus musculus ssp.

Aesthetic attributes and Values of feral mice: Similar to those of *Rattus*. Less injurious than *Rattus*, the house mouse damages man's materials, eats his foods, and is a vector of several diseases transmitted to man. Eats some injurious seeds and insects.

Status: This introduced pest is more abundant than *Rattus*, and is confined generally to human habitations (but often feral in summer). Occurs especially in southern counties.

Distribution: Throughout watershed (not mapped).

Specimens examined: Wisconsin: Marinette Co., 8 mi. N Marinette (1); Oconto Co., 4 mi. NW Oconto Falls (1); Racine Co., no specific locality (1). *Other records:* Wisconsin: Numerous counties (McCabe, 1972 and Jackson, 1961:258). Michigan: Scattered records in counties on Upper and Lower Peninsulas, and on North Manitou Island (Burt, 1948:232). Beaver Island (Ozoga and Phillips, 1964). Illinois: Chicago (Cory, 1912:179). Indiana: Porter and St. Joseph counties (Lyon, 1936).

ZAPODIDAE - JUMPING MICE

Zapus hudsonius (Zimmermann). MEADOW JUMPING MOUSE.

Zapus hudsonius intermedius Krutzsch.

Aesthetic attributes: An exquisite combination of orange and pure white; a delicately formed, clean-looking, saltatorial mouse. This mammal hibernates and is a competent swimmer.

Values: Causes no significant damage to crops because its habitats are wet woods, swamps, and marshes. The species is a valuable herbivore in complex food chains in mesic habitats; preyed upon by snakes, marsh hawks, weasels, foxes, and other carnivores. Feeds primarily on seeds, grasses, and other marsh plants.

Status and Distribution: Found in abundance throughout the southern counties of Wisconsin and northern Illinois in suitable habitats (Fig. 25), but is not recorded on islands or the Door Peninsula.

Specimens examined: Wisconsin: Manitowoc Co., 1 mi. N Manitowoc (1); Outagamie Co., 2 mi. S Appleton (1); Waukesha Co., 30mi. NW Kenosha (1). *Other records:* Wisconsin: Numerous counties (Jackson, 1961:263). Illinois: Lake Co., Fox Lake (Cory, 1912:252 and Krutzsch, 1954); Cook Co., (Necker and Hatfield, 1941).

Zapus hudsonius hudsonius (Zimmermann).

Aesthetic attributes, Values, and Status as in *Zapus hudsonius intermedius*.

Distribution: Upper Peninsula of Michigan and some northern counties in Wisconsin (Fig. 25).

Specimens examined: Wisconsin: Florence Co., Chipmunk Rapids campsites (5); Oconto Co., 11 mi. NE Suring (1), 4 1/2 mi. W Oconto Falls (1). Michigan: Delta Co., 15 mi. E Escanabe, on Stonington Peninsula (1). *Other records:* Numerous counties in northern Wisconsin and upper Michigan (Burt, 1948:234 and Jackson, 1961:263).

Zapus hudsonius americanus (Barton).

Aesthetic attributes, Values, and Status as in *Zapus hudsonius intermedius*.

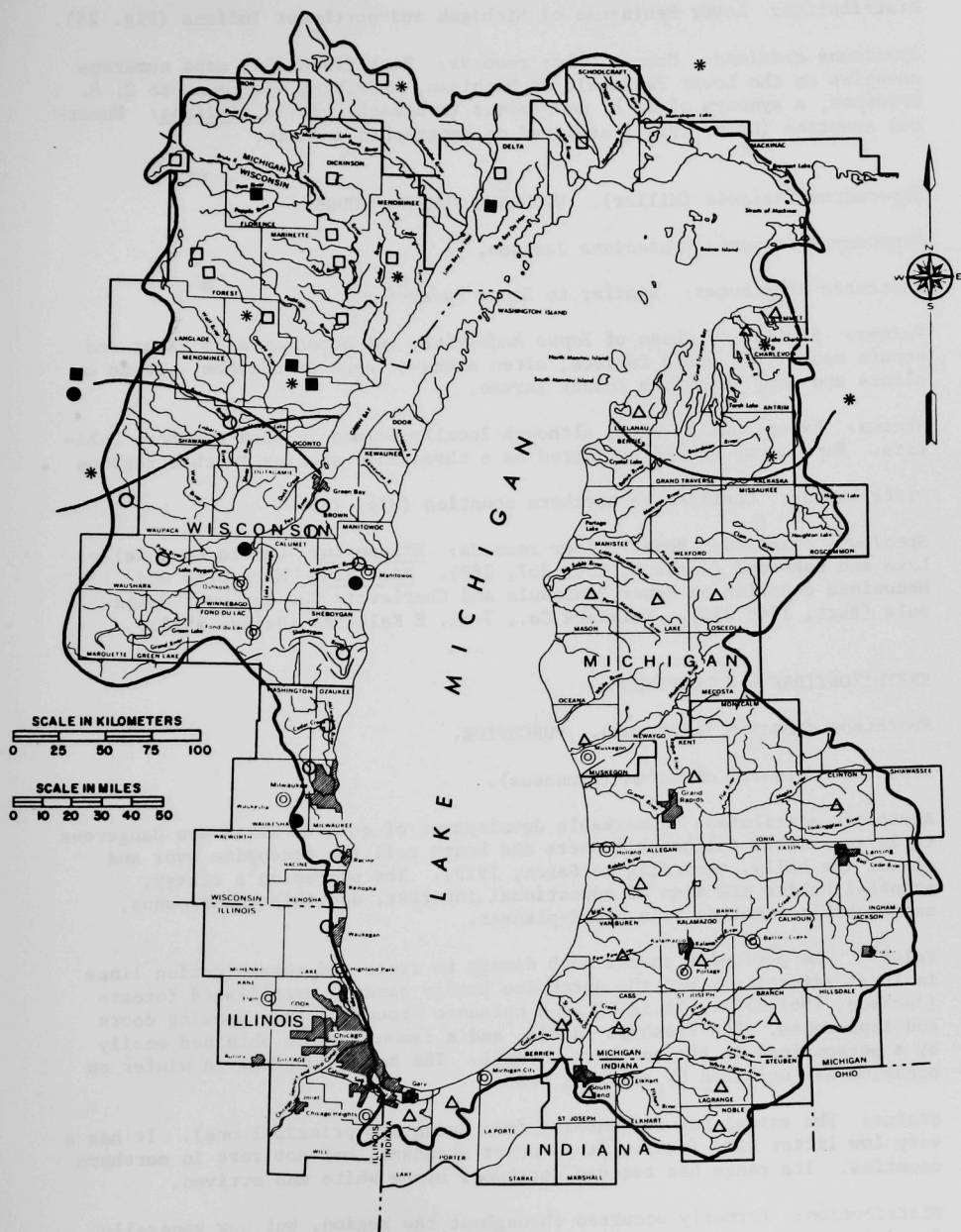


Fig. 25. Distribution of *Zapus hudsonius hudsonius* (squares), *Z. h. intermedius* (circles), *Z. h. americanus* (triangles), and *Naepozapus insignis*

Distribution: Lower Peninsula of Michigan and northwest Indiana (Fig. 25).

Specimens examined: None. *Other records:* Burt (1948:234) maps numerous counties on the Lower Peninsula of Michigan, ascribing specimens to *Z. h. brevipes*, a synonym of *Z. h. americanus* (Kruttsch, 1954). Indiana: Numerous counties (Lyon, 1936), assigned on geographic grounds.

Napeozapus insignis (Miller). WOODLAND JUMPING MOUSE.

Napeozapus insignis fruteactans Jackson.

Aesthetic attributes: Similar to *Zapus hudsonius*.

Values: Similar to those of *Zapus hudsonius*, but *Napeozapus* is rarer and occurs usually in mesic forests, often along streams or marshes. Feeds on plants and many injurious insect larvae.

Status: Exceptionally rare, although locally common in some northern habitats. *Napeozapus* should be listed as a threatened species in this region.

Distribution: Confined to northern counties (Fig. 25).

Specimens examined: None. *Other records:* Wisconsin: Oconto Co., Kelly Lake and Lakewood (Jackson, 1961:267, 269). Michigan: Marquette and Menominee counties on Upper Peninsula and Charlevoix Co. on Lower Peninsula (Burt, 1948:236). Kalkaska Co., 7 mi. E Kalkaska (Dalby, 1968).

ERETHIZONTIDAE - PORCUPINES

Erethizon dorsatum (Linnaeus). PORCUPINE.

Erethizon dorsatum dorsatum (Linnaeus).

Aesthetic attributes: Remarkable development of quills, which are dangerous to large animals (although fishers and bears roll the porcupine over and attack the belly, according to Seton, 1929). The porcupine's clumsy, arboreal habits are also of educational interest, and this conspicuous, approachable creature is a crowd-pleaser.

Values: The porcupine causes much damage to trees and communication lines in local situations, but the porcupine hardly damages established forests (Jackson, 1961:277). It is often a nuisance around cabins, gnawing doors and implements. The flesh is edible, and a famous source obtained easily by a person lost in the northern forests. The bark droppings in winter on occasion are utilized by starving deer.

Status: The animal has few enemies (man being its principal one). It has a very low litter size (one). It is never abundant, but not rare in northern counties. Its range has receded northward since white man arrived.

Distribution: Formerly occurred throughout the region, but now generally found in northern counties (Fig 26).

Specimens examined: Wisconsin: Forest Co., Alvin (1), Pickerel Lake (1); Marinette Co., no specific locality (1). *Other records:* Wisconsin: Numerous localities north of Green Bay. Also, Sheboygan Co. and Door Co. (before 1870) (McCabe, 1972 and Jackson, 1961:272). Michigan: Numerous counties on Upper and Lower Peninsulas (Burt, 1948:240). Indiana: Numerous counties (Lyon, 1936).

ORDER CARNIVORA--MEAT EATERS

CANIDAE - DOGS

Canis latrans Say. COYOTE. Also called brush wolf.

Canis latrans thomomys Jackson.

Aesthetic attributes: A person is lucky to see such a large and beautiful wild animal in the wilderness; its calling at night provides one of the finest experiences in sound that nature offers. The fur is shaggy and rich in the prime pelts. The coyote is usually considered adaptable and clever.

Values: The coyote is a valuable fur-bearer and is often mentioned as a potential game animal. Being a predator, it helps control populations of often-injurious rabbits and mice, and probably, as an opportunist, occasionally, takes a farmer's chicken or a fawn. Often the coyote feeds on carrion and insects. A typical predator, the coyote tends to feed on sickly and aged animals in the wild. It is maligned as a killer of stock and deer. This reputation, partly deserved, often helps stockmen legislate bounties, which make this species a local economic resource to farmers and coyote hunters.

Status: The species should be protected and is listed as threatened, at present. R. H. Baker (*in litt.*, 1973) writes that coyotes are unusual south of Clare, Michigan.

Distribution: Ranges generally through the watershed, found on Washington Island (Fig. 27).

Specimens examined: Wisconsin: Marinette Co., 2 mi. W Middle Inlet (1). Michigan: Schoolcraft Co., Seney (1). *Other records:* Wisconsin: Numerous counties (Jackson, 1961:285). Michigan: Listed as *Canis latrans latrans* Say, numerous counties on Upper and Lower Peninsulas (Burt, 1948:161). Montcalm and Ingham counties (Ozoga and Gaertner, 1963). Garden Island (Phillips *et al.*, 1965) and Beaver Island (Ozoga and Phillips, 1964). Illinois: Cook Co. (Cory, 1912:323). Indiana: Numerous counties (Lyon, 1936).

Canis lupus Linnaeus. TIMBER WOLF.

Canis lupus lycaon Schreber.

Aesthetic attributes: Burt (1948) listed the species as the most "majestic" of the mammalian fauna of Michigan. Certainly the species is prominent in the American heritage, as a character of children's stories, and as a reputed killer of men. Recent studies by Mech (1970) and Mech and Frenzel (1971) reveal interesting facts about the social behavior of the wolf and show its role in the environment in relation to deer and moose, a role which can be preserved in some remote places at no expense to man.

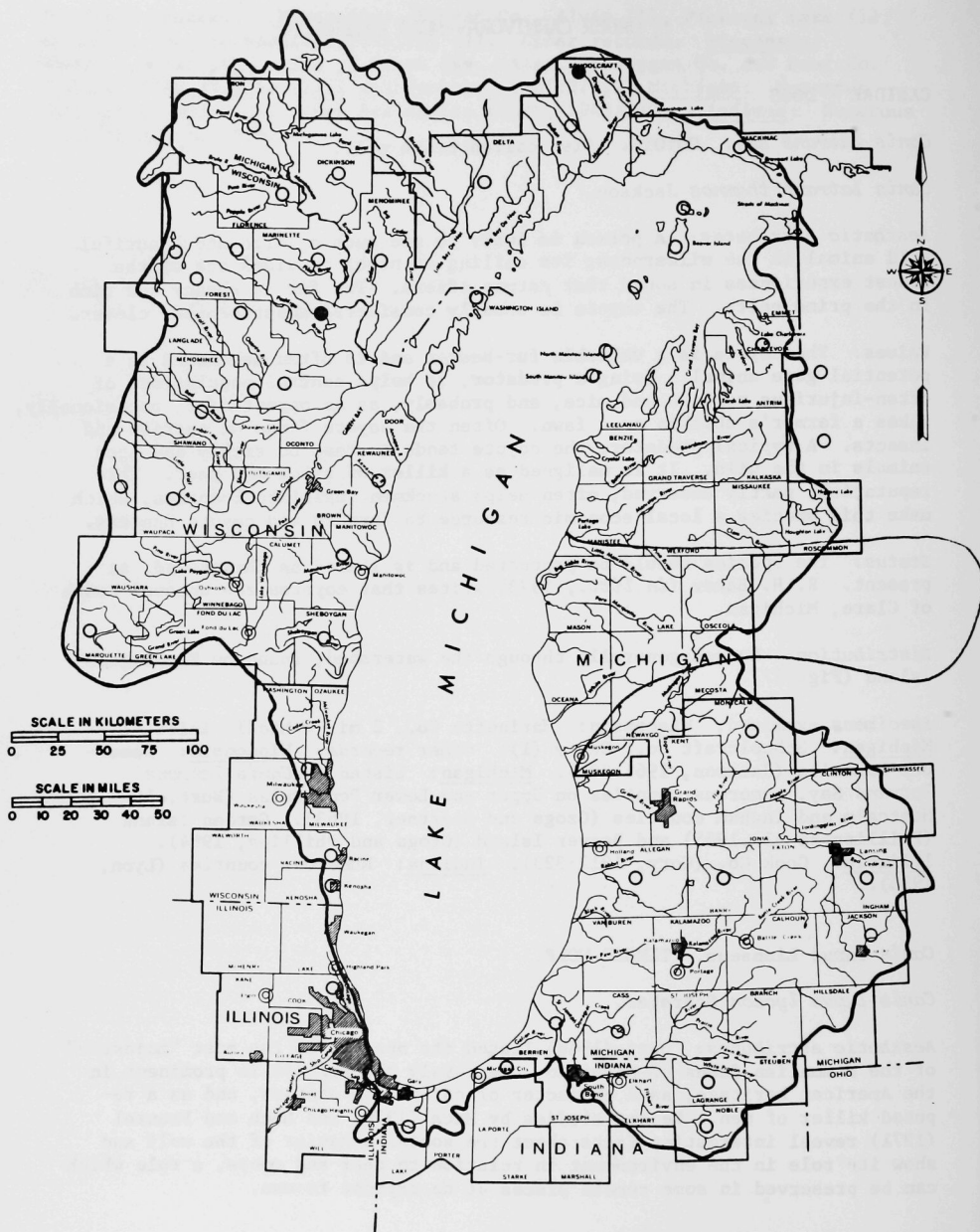


Fig. 27. Distribution of *Canis latrans*.

Values: The wolf is a predator of big game, including moose and deer, but feeds mostly on small mammals and a few birds. Wolves eat carrion, but the pack is an efficient social organization for ridding game herds of aged and sickly members. Wolf fur was once commercially valuable. Certainly wolves throughout North America have severely preyed upon domestic stock, and even in nature their predation has been severe. By management in remote parts of North America, the wolf's negative effects can be neutralized and the species preserved.

Status: Possibly present in the northern counties; the Wisconsin Department of Natural Resources has recently listed the small population in the Nicolet National Forest (Florence County) as extirpated. Ralph Bailey, Michigan Department of Natural Resources in Marquette, states that the timber wolf is still present on the Upper Peninsula. Recent observations by competent observers are as follows:

Marquette Co., T49N, R30W, Sec. 11--April 27, 1972
 Mackinac Co., T43N, R7W, Sec. 22--May 16, 1972
 Mackinac Co., T43N, R7W, Sec. 15, 21, 22--May 21, 1972
 Baraga Co., T47N, R33W, Sec. 14--Nov. 15, 1972
 Iron Co., T45N, R37W, Sec. 33--May 13, 1970
 Mackinac Co., T42N, R6W, Sec. 7--Nov. 6, 1970.

Specimens examined: None. **Other records:** Wisconsin: Numerous records in 1900 or later in northern counties (McCabe, 1972 and Jackson, 1961:293); numerous earlier records in most counties. Michigan: Numerous early-day records on Lower Peninsula, a few specimens from Schoolcraft, Marquette, and Dickinson counties on Upper Peninsula, and other records there in Delta and Menominee counties (Burt, 1948:163). Illinois: Formerly in Cook Co. (Cory, 1912:316). Indiana: Formerly in Porter, Laporte, St. Joseph, Elkhart and LaGrange counties (Lyon, 1936).

Vulpes vulpes (Linnaeus) (Formerly *Vulpes fulva*). RED FOX.

Vulpes vulpes fulvus (Desmarest).

Aesthetic attributes: A strikingly beautiful animal.

Values: This carnivore preys chiefly on rodents, rabbits, and occasional birds, helping control prey populations and ridding them of sickly and aged individuals. The fur is valuable, and the species is often hunted as a game animal. Foxes are shot, trapped, and road kills picked up to earn bounty payments in some counties. The bounties are worth almost as much as the furs, providing a bit of "welfare" to fox hunters.

Status: In spite of hunting, trapping, and bounties the red fox remains an abundant predator.

Distribution: Throughout watershed, except absent from a few islands, perhaps occurring on Washington Island (Jackson, 1961) (Fig. 28).

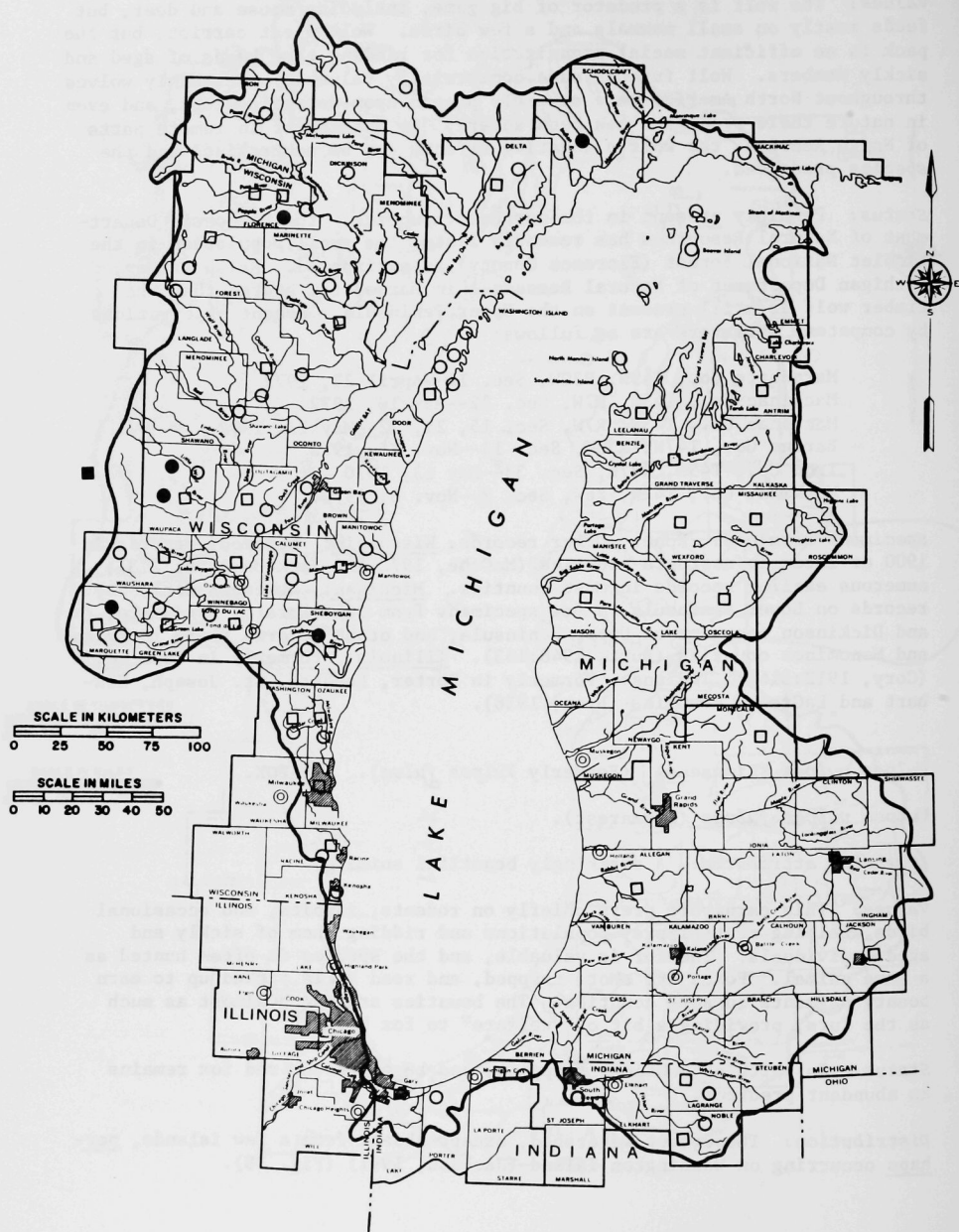


Fig. 28. Distribution of *Vulpes vulpes* (circles) and *Urocyon cinereoargenteus* (squares).

Specimens examined: Wisconsin: Florence Co., no specific locality (1); Waupaca Co., 8 1/2 mi. S Marion (1), 5 mi. E Clintonville (1); Marquette Co., 1 mi. E Harrisville, Hwy E, (1); Sheboygan Co., no specific locality (1). Michigan: Schoolcraft Co., 4 mi. N Manistique (1). *Other records:* Wisconsin: Numerous counties (Jackson, 1961:301). Michigan: Numerous counties on Upper and Lower Peninsulas and widely occurring on islands (Burt, 1948:156). Indiana: Numerous counties (Lyon, 1936).

Urocyon cinereoargenteus (Schreber). GRAY FOX.

Urocyon cinereoargenteus ocythous Bangs.

Aesthetic attributes: A beautiful wild canid, the social and denning habits of which are interesting.

Values: An able mouser, preys also on rabbits and a few birds, occasionally steals a chicken or kills a grouse, but is generally beneficial to man. The fur is about half as valuable as that of the red fox. The gray fox, unfortunately, is hunted and bountied in some counties.

Status: Rarer than the red fox and possibly threatened.

Distribution: Sparsely distributed throughout the watershed of Lake Michigan, but unknown on islands (Fig. 28). Uncommon in northern counties, decreasing (McCabe, 1972).

Specimens examined: None. *Other records:* Wisconsin: Numerous counties (McCabe, 1972 and Jackson, 1961:308). Michigan: Delta Co. (Burt, 1948).

Urocyon cinereoargenteus cinereoargenteus Schreber.

Aesthetic attributes, Values, and Status as in *Urocyon cinereoargenteus ocythous*, except this threatened subspecies is rare.

Specimens examined: None. *Other records:* Michigan: Numerous records (but no specimens) from the Lower Peninsula (Burt, 1948:158). Indiana: Numerous counties (Lyon, 1936).

URSIDAE - BEARS

Ursus americanus Pallas. BLACK BEAR.

Ursus americanus americanus Pallas.

Aesthetic attributes: A magnificent and beautiful large mammal, the largest carnivore in the watershed. The black bear is scansorial, omnivorous, sleeps in torpor during the winter, and is a solitary, unsociable mammal. A popular character of fact and fiction, it is a rather intelligent, majestic beast of which even the tracks provide memorable recollections.

Values: The bear is hunted legally for sport and meat, which is as delicious as fine beef. The fur is used for decorative rugs. The bear is a scavenger: it feeds on berries, honey combs, insects, roots, and many other items. It has few enemies aside from man, which it injures by preying on stock and raiding apiaries.

Status: Rare and protected.

Distribution: Formerly throughout the watershed, but now confined to northern counties, including the Door Peninsula, and to central Wisconsin, but absent from the islands in the lake. R. H. Baker (*in litt.*, 1973) writes that now *Ursus* does not range southward of Clare, Michigan (Fig. 29).

Specimens examined: None. *Other records:* Wisconsin: Numerous counties before 1900 (Jackson, 1961:313). Recorded (to 1935) from Waushara, Brown, and Door counties as well as northern counties. Michigan: Upper Peninsula and northern counties of Lower Peninsula, formerly throughout state (Burt, 1948:122-123). Illinois: Formerly in Cook Co. (Cory, 1912:398). Indiana: Formerly in Lake, Porter, Laporte, St. Joseph (1840), Elkhart, LaGrange (1878), Noble (1860), and Steuben counties (Lyon, 1936).

PROCYONIDAE - RACCOONS, ETC.

Procyon lotor (Linnaeus). RACCOON. Also called 'coon.

Procyon lotor hirtus Nelson and Goldman.

Aesthetic attributes: Presents a handsome appearance. Generally its friendly, inquisitive, bumbling behavior endears the raccoon to tourists and naturalists alike. The habit of catching aquatic invertebrates, the reputed but seldom observed technique of washing its food, climbing and denning in hollow trees, and a place in American history (the coonskin cap) are of interest.

Values: The raccoon is hunted often with hounds. The fur and meat are of value. The raccoon feeds on a variety of items, including crayfish, berries, carrion, insects, mice, tender buds and shoots, and the farmer's corn and occasionally his hens' eggs. One of its predators is the fisher, known better for its porcupine prey.

Status and Distribution: Abundant for a carnivore though seldom seen, throughout the western Lake Michigan drainage area. Not mapped. Burt (1948:125) reports the raccoon as "rare" on the Upper Peninsula of Michigan.

Specimens examined: Wisconsin: Manitowoc Co., 1 mi. E Cato (1); Waupaca Co., 10 mi. W Fremont, Hwy 10, (1), 3 mi. NW Waupaca (2); Marquette Co., Harrisville (1). *Other records:* Wisconsin: Numerous counties (McCabe, 1972 and Jackson, 1961:323). Michigan: Numerous counties on Upper Peninsula (Burt, 1948:120). Illinois: Chicago (Cory, 1912:306).

Procyon lotor lotor (Linnaeus).

Aesthetic attributes, Values and Status as in Procyon lotor hirtus.

Distribution: Michigan: Numerous counties on Lower Peninsula and North Manitou Island (Burt, 1948). Beaver Island after 1956 (Ozoga and Phillips, 1964). Indiana: St. Joseph, LaGrange, and Noble counties (Lyons, 1936). Not mapped.

MUSTELIDAE - WEASEL, ERMINE, MINK

Mustela frenata Lichtenstein. LONG-TAILED WEASEL.

Mustela frenata moveboracensis (Emmons).

Aesthetic attributes: This exceptionally quick, fearless, and aggressive large weasel with dense, beautiful fur is an impressive, handsome carnivore. The weasel's beauty and fearless predation, the anal scent glands, and the adaptations for carnivorous diet are of interest.

Values: The fur is valuable, and its predation on mice, rabbits, and even hares is valuable in their population regulation.

Status: Seldom seen, and uncommon even for carnivores, perhaps rare. The species is protected.

Distribution: Probably occurs throughout the region (Fig. 30), perhaps absent from islands.

Specimens examined: Wisconsin: Door Co., 2 mi. S Sturgeon Bay (1); Manitowoc Co., Manitowoc (1); Winnebago Co., Pickett (1); Marquette Co., no specific locality; Racine Co. (1). *Other records:* Wisconsin: Numerous counties, records especially numerous in southern counties and in Door Co. (Jackson, 1961:347). Michigan: Numerous counties on Upper and Lower Peninsulas, Marion Island (Burt, 1948:136). Illinois: Cook Co. (Cory, 1912:366); Lake Co. (Necker and Hatfield, 1941). Indiana: Numerous counties (Lyons, 1936).

Mustela erminea Linnaeus. ERMINE. Also called short-tailed weasel.

Mustela erminea bangsi Hall.

Aesthetic attributes and Values: Similar to those in *Mustela frenata*.

Status: Protected and generally more abundant than *M. frenata* or *M. nivalis*, especially in marshes and mesic forests.

Distribution: Ranges southward from northern counties, but not known on islands. Absent in Illinois and northern Indiana (Fig. 30).

Specimens examined: Wisconsin: Door Co., 6 mi. W Sturgeon Bay (1); Menominee Co., Keshena (1); Calumet Co., Chilton (1); Green Lake Co., Berlin (1).

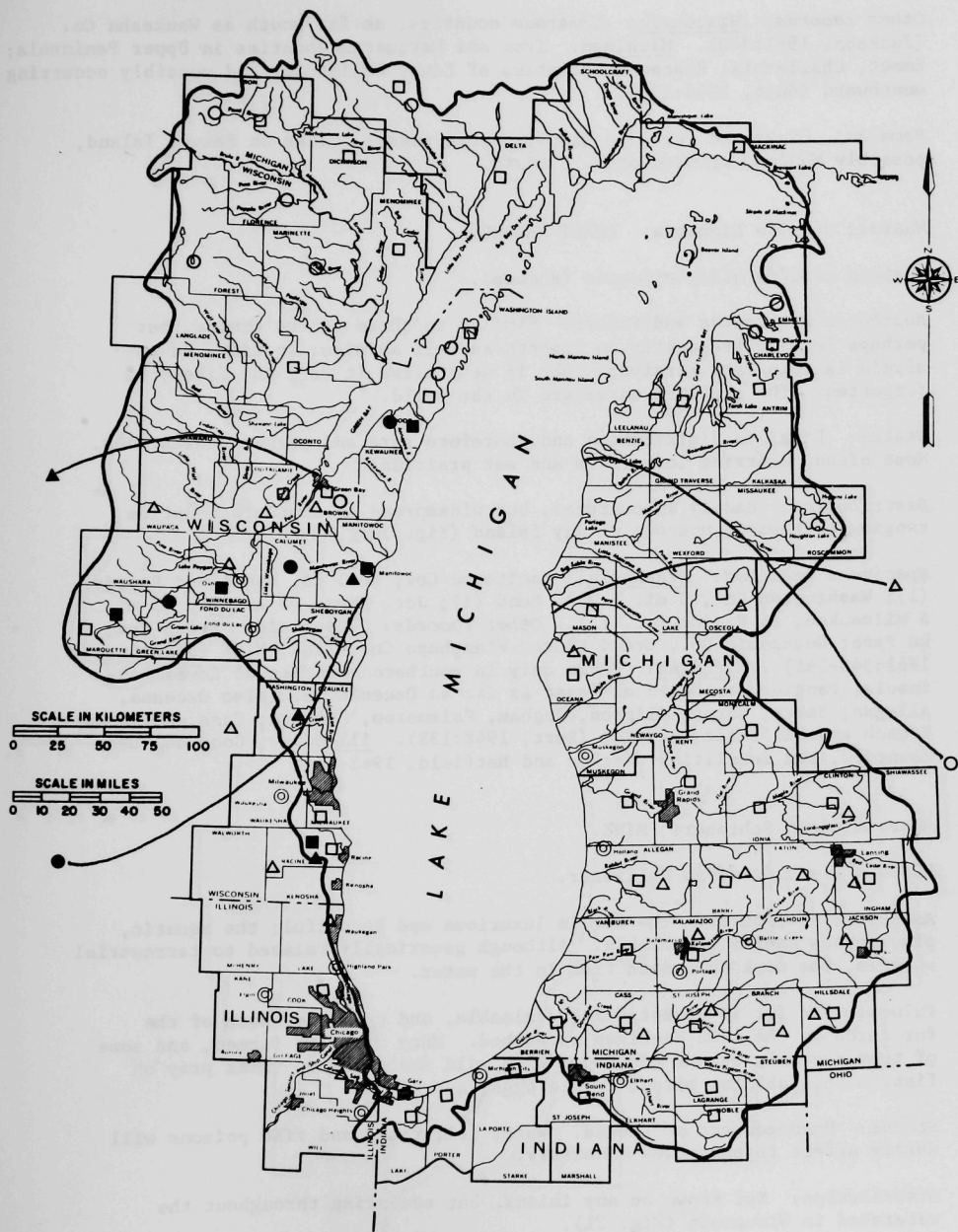


Fig. 30. Distribution of *Mustela frenata* (squares), *M. nivalis* (triangles), and *M. erminea* (circles).

Other records: Wisconsin: Numerous counties, as far south as Waukesha Co. (Jackson, 1961:340). Michigan: Iron and Marquette counties in Upper Peninsula; Emmet, Charlevoix, Roscommon counties of Lower Peninsula, and possibly occurring southward (Burt, 1948:133).

Remarks: Ozoga and Phillips (1964) report weasel tracks on Beaver Island, possibly *Mustela erminea* or *M. frenata*.

Mustela nivalis Linnaeus. LEAST WEASEL.

Mustela nivalis allegheniensis (Rhoads).

Aesthetic attributes and Values: Similar to those of the ermine, but perhaps feeding frequently on insects as well as mice; so tiny and unafraid is this rare carnivore that if seen alive it will not likely be forgotten. The smallest carnivore in the world.

Status: Local in distribution and therefore rare and perhaps threatened. Most often occurring in marshes and wet prairies.

Distribution: Rarely encountered, but widespread in southern counties ranging northward; unknown on any island (Fig. 30).

Specimens examined: Wisconsin: Manitowoc Co., Sec. 18, Manitowoc Rapids (1); Washington Co., 5 mi. E West Bend (1); Jct. Hwys. 38 and 31, 22 mi. S Milwaukee, in Racine Co., (1). *Other records:* Wisconsin: Brown Co., De Pere; Outagamie Co., Grand Chute; Winnebago Co., T18N, R15E (Jackson, 1961:344-345). Michigan: Known only in southern counties of Lower Peninsula, ranging northward at least as far as Osceola Co. (also Osceana, Allegan, Barry, Eaton, Clinton, Ingham, Kalamazoo, Jackson, Cass, St. Joseph, Branch and Hillsdale counties (Burt, 1948:138). Illinois: Cook and Lake counties, ten localities (Necker and Hatfield, 1941-46).

Mustela vison Schreber. MINK.

Mustela vison letifera Hollister.

Aesthetic attributes: The fur is luxurious and beautiful; the aquatic, piscivorous habits remarkable. Although generically related to terrestrial weasels, the mink can catch fish in the water.

Values: The fur is exceptionally valuable, and comprises much of the fur catch in the Lake Michigan watershed. Many mink are farmed, and some of them probably escape and breed with wild individuals. Mink prey on fish, mice, rabbits, birds, turtle eggs, and frogs.

Status: Uncommon and protected. Water pollutants and fish poisons will surely affect this species adversely.

Distribution: Not known on any island, but occurring throughout the watershed in Wisconsin (Fig. 31).

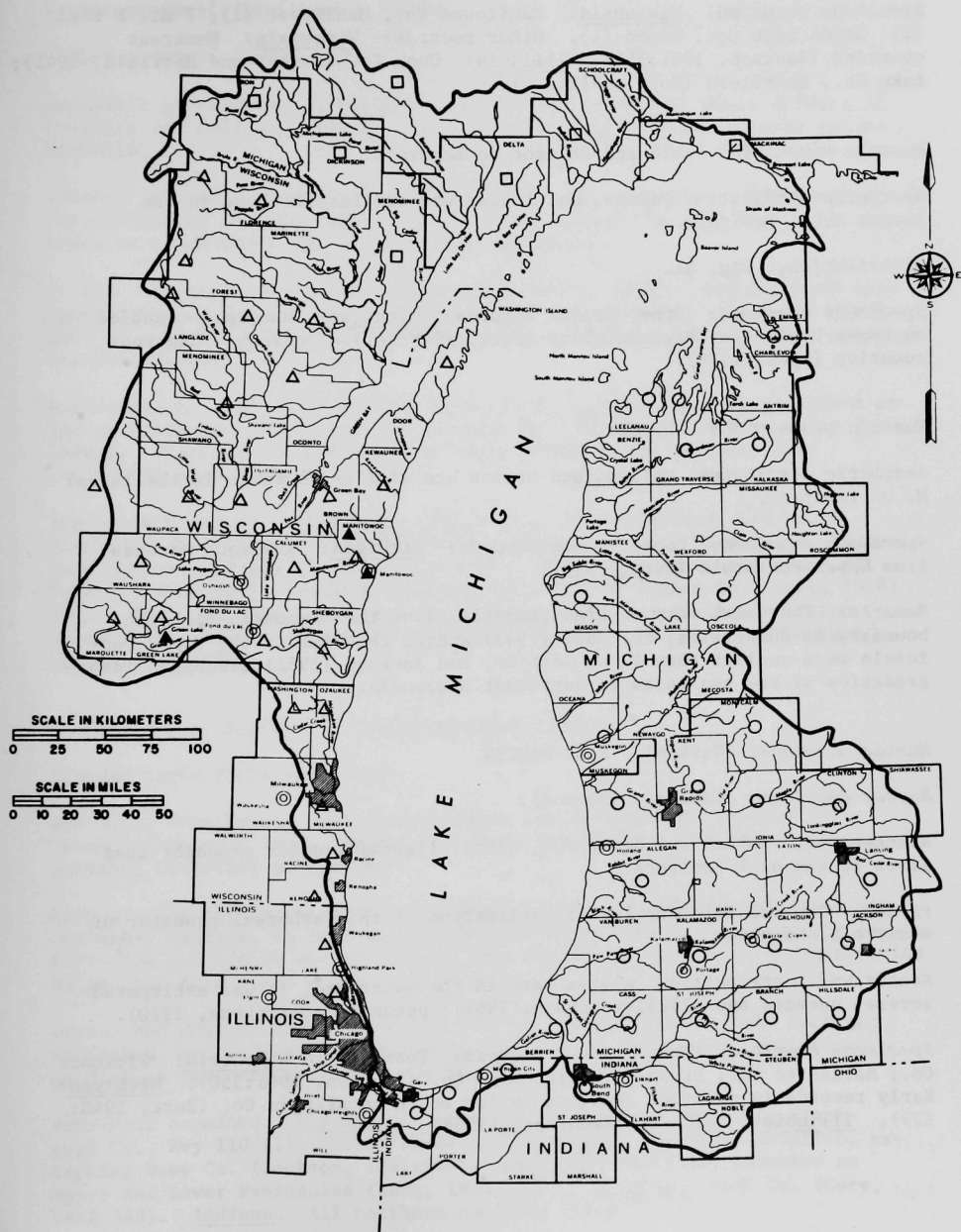


Fig. 31. Distribution of *Mustela vison*. *M. v. vison* (squares), *M. v. letifera* (triangles), and *M. v. mink* (circles).

Specimens examined: Wisconsin: Manitowoc Co., Manitowoc (1), 7 mi. N Kiel (1); Green Lake Co., Ripon (1). *Other records:* Wisconsin: Numerous counties (Jackson, 1961:353). Illinois: Cook Co. (Necker and Hatfield, 1941); Lake Co., Deerfield (Cory, 1912:366).

Mustela vison mink Peale and Palisot de Beauvois.

Aesthetic attributes, Values, and Status are similar to those in the larger *M. v. letifera*.

Distribution: Fig. 31.

Specimens examined: None. *Other records:* Michigan: Numerous counties on Lower Peninsula, Marion Island (Burt, 1948:141). Indiana: Numerous counties (Lyon, 1936).

Mustela vison vison Schreber.

Aesthetic attributes, Values, and Status are similar to those in the larger *M. v. letifera*.

Specimens examined: None. *Other records:* Michigan: Numerous records from Upper Peninsula (Burt, 1943).

Remarks: That mink vary so significantly along the Wisconsin-Michigan boundary is surprising, but Burt (1943) stated the mink of the Upper Peninsula were smaller than *M. v. letifer*, and Jackson (1961) discussed intergradation of the two races in northeast Wisconsin.

Martes americana (Turton). PINE MARTEN.

Martes americana americana (Turton).

Aesthetic attributes: A beautiful, alert, lightning-quick predator that lives in the high conifers.

Values: The valuable fur led to extirpation of this arboreal predator of squirrels and mice.

Status and Distribution: Always rare in the watershed, it was extirpated several decades ago (1925) (Jackson, 1961); perhaps later (Long, 1970).

Specimens examined: None. *Other records:* Formerly in Wisconsin: Florence Co.; Marinette Co.; Brown Co.; Winnebago Co. (Jackson, 1961:330). Michigan: Early records in numerous counties as far south as Allegan Co. (Burt, 1948: 129). Illinois: Cook Co. (Kennicott, 1858).

Martes pennanti (Erxleben). FISHER.

Martes pennanti (Erxleben).

Aesthetic attributes: A typically beautiful mustelid of dense forests of conifers and deciduous trees. The act of rolling a porcupine over is remarkable.

Values: The fur is exceptionally valuable. This predator helps control populations of snowshoe hares and raccoons, as well as many mice. It also preys on a few birds and an occasional porcupine.

Status: Perhaps exterminated about 1940 (DeVos, 1964). Reintroduced into upper Michigan and northern Wisconsin, where it persists. In upper Michigan, 16 animals were released in 1962 and 14 in 1963 (Bailey, 1973, personal correspondence).

Distribution: Formerly occurred in northern forests, ranging southward as far as Milwaukee, Wisconsin, and Allegan Co., Michigan. Not known on any island. Presently reintroduced in upper Michigan and northern Wisconsin (Nicolet Forest).

Specimens examined: Wisconsin: Vilas Co., reintroduction, 1/4 mi. E Pine Lake (1) [taken 27 October 1966]. **Other records:** Wisconsin: Formerly in numerous counties (Jackson, 1961:335). Michigan: Northern counties, formerly extending southward on Lower Peninsula to Ingham Co. (Burt, 1948:131). Iron, Dickinson, Delta, and Marquette counties (Bailey's letter of April 11, 1973). Illinois: Cook Co., formerly "along Lake Michigan" (Cory, 1912:389).

Taxidea taxus (Schreber). NORTH AMERICAN BADGER.

Taxidea taxus jacksoni Schantz.

Aesthetic attributes: The fierce badger has its handsome aspects in fresh pelage on a sandy prairie but shows few of them in a cage. Remarkable fossorial adaptations.

Values: The fur is valuable. The badger feeds on numerous injurious mice and other rodents, as well as a variety of other items. Occasionally damages hillsides and fields and is said to lame horses and cattle on account of its holes (but this claim may be exaggerated).

Status and Distribution: Probably rare or uncommon in the Lake Michigan watershed, but widely distributed in appropriate unforested habitats such as drained marshes, prairies, and fields (Fig. 32).

Specimens examined: Wisconsin: Kewaunee Co., Pierce Twsp (1); Winnebago Co., Hwy 110 (1). **Other records:** Wisconsin: Numerous counties, excepting Door Co. (Jackson, 1961:365). Michigan: Numerous counties on Upper and Lower Peninsulas (Burt, 1948:153). Illinois: Cook Co. (Cory, 1912:349). Indiana: All northern counties (Lyon, 1936).

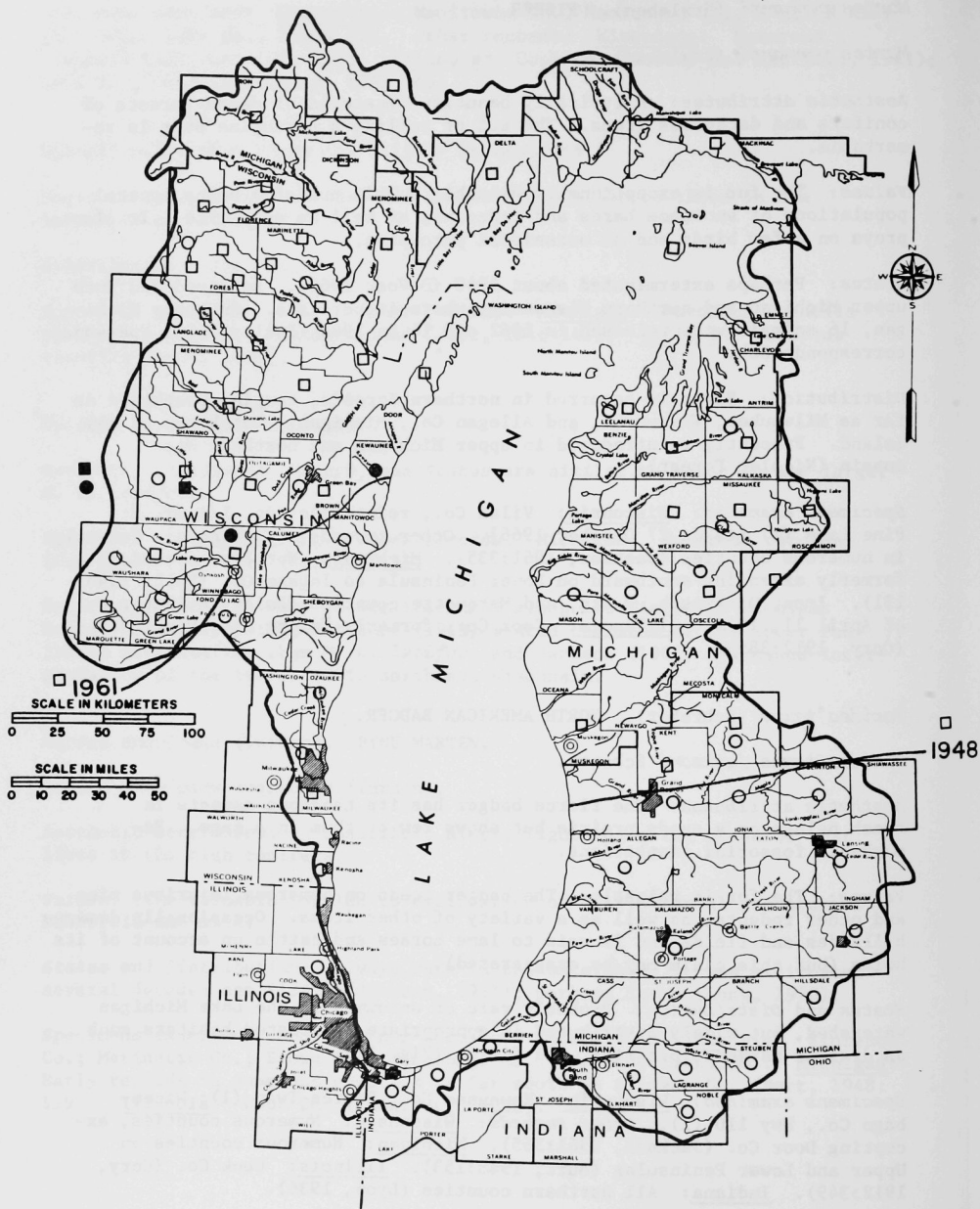


Fig. 32. Distribution of *Taxidea taxus* (circles) and *Lutra canadensis* (squares), otter formerly ranged throughout watershed.

Lutra canadensis (Schreber). *Lontra canadensis* according to Van Zyll de Jong. RIVER OTTER.

Lutra canadensis canadensis Schreber.

Aesthetic attributes: Has the most luxurious fur of any furbearer in the watershed. Observation of an otter playing about in the waters of a northern lake can provide a happy memory. Remarkably adapted to aquatic life. Its otter slides and play are interesting.

Values: A valuable furbearer that feeds on numerous aquatic vertebrates and invertebrates, particularly forage fishes and frogs. About 20 per cent of its diet is pan fish and game fish together (Jackson, 1961).

Status: Once nearly exterminated in the United States, otters are fairly common, under protection, in northern waters of the watershed. Pollution and fish poisons will doubtlessly affect otters, because ridding a stream or lake of forage fishes removes the otter's food source. Knudsen (1956) lists otters as very rare south of the Fox River and Lake Winnebago today.

Distribution: Fig. 32.

Specimens examined: Wisconsin: Waupaca Co., Scandinavia (1). *Other records:* Wisconsin: Numerous counties (Jackson, 1961:384). Michigan: Numerous counties on Upper Peninsula and a few northern counties on Lower Peninsula (Kalkaska, Missaukee Counties) (Burt, 1948:147). Early records are numerous throughout Lower Peninsula. Reported from Beaver Island. Illinois: Cook Co. (Cory, 1912:330); Lake Co. (Necker and Hatfield, 1941). Indiana: Lake, Porter, Laporte, St. Joseph (1909), Elkhart, and Nobel (1863) counties (Lyon, 1936).

Mephitis mephitis (Schreber). STRIPED SKUNK.

Mephitis mephitis hudsonica Richardson.

Aesthetic attributes: The scent is a very negative attribute but the fur is very beautiful. Viewing their comical antics, especially of a mother with young, provides an interesting experience.

Values: The fur is valuable. The striped skunk is an able mouser and feeds on countless insects. These skunks also feed on a variety of other items such as carrion or eggs. Unfortunately, the skunk is frequently a vector of rabies and rarely of tularemia.

Status: For a carnivore, abundant.

Distribution: Throughout the region west of Lake Michigan (Fig. 33).

Specimens examined: Wisconsin: Manitowoc Co., Manitowoc, Jct. Hwys. 141 and 110 (1). *Other records:* Wisconsin: Numerous counties (Jackson, 1961:377). Michigan: Numerous counties on Upper Peninsula (Burt, 1948:150).

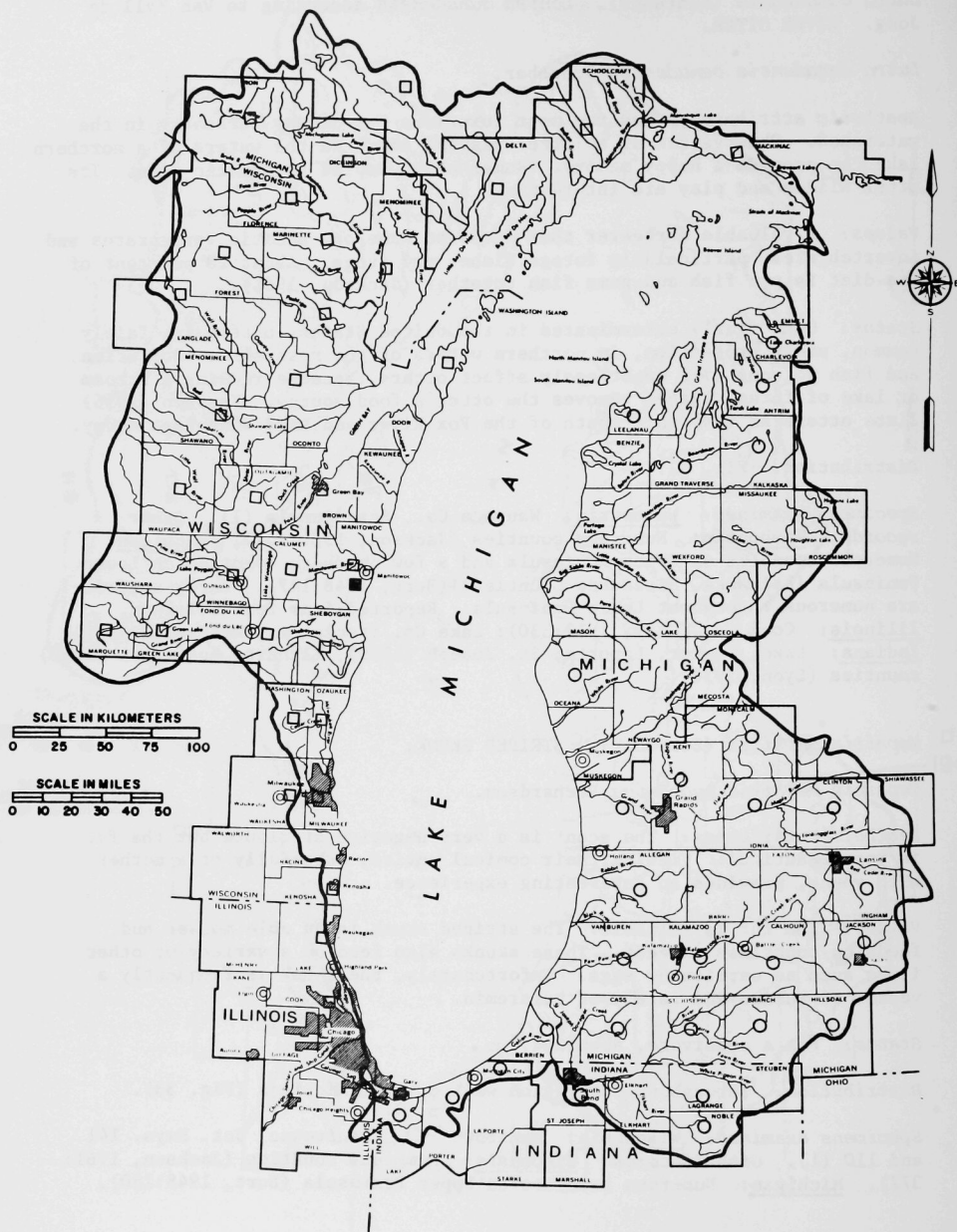


Fig. 33. Distribution of *Mephitis mephitis*. *M. m. hudsonica* (squares) and *M. m. nigra* (circles).

Mephitis mephitis nigra (Peale and Palisot de Beauvois).

Description, Aesthetic attributes, Values, and Status similar to those of *Mephitis m. hudsonica*.

Distribution: Fig. 33. Absent from islands, occurs east of Lake Michigan.

Specimens examined: None. Other records: Michigan: Numerous counties on Lower Peninsula (Burt, 1948:150). Indiana: Numerous northern counties (Lyon, 1936). Illinois: Cook and Lake counties, possibly referable to *M. m. hudsonica* (Necker and Hatfield, 1941).

Gulo gulo (Linnaeus). WOLVERINE. Also called karkajou.

Gulo gulo luscus (Linnaeus).

Aesthetic attributes: A large, typically beautiful mustelid, but its predation rests more on strength and cunning than on typically mustelid grace and quickness; voracious and incredibly strong.

Values: A furbearer, and a predator of rabbits, small mammals, beavers, and mice, occasionally preying on bigger game such as deer and even attacking larger animals on occasion.

Status: Exterminated about 1900, possibly as late as 1922.

Specimens examined: None. Other records: Michigan: Marquette and Schoolcraft counties on Upper Peninsula; Leelanau and Kent counties on Lower Peninsula (Burt, 1948:144). Indiana: Noble Co. (1840) (Lyon, 1936).

FELIDAE - CATS

Felis concolor True. MOUNTAIN LION. Also called cougar.

Felis concolor shorgeri Jackson.

Aesthetic attributes: A sleek and graceful big cat, a character greatly feared and admired in fiction and fact in American literature.

Values: Mountain lion fur has been valued and the meat is excellent. Lions are hunted usually with hounds. This carnivore preys chiefly on deer and is a natural check on deer population irruptions. Today man harvests surplus deer, but most managers feel the deer are too abundant for their own good (starving, falling to disease) and for the good of proper forest development. Mountain lions, if present, would probably rid the region of some of the starving animals. Incidentally, there are very few reports of cougars attacking man in the history of Canada and the U.S.A.

Status: Exterminated, about 1850 in Indiana, about 1900 in Wisconsin, approximately 1840 to 1860 in Illinois (Cory, 1912).

Former distribution: Generally throughout the region, except unknown on any island (Not mapped).

Specimens examined: None. *Other records:* Wisconsin: Formerly in Marinette Co.; Waupaca Co.; Outagamie Co., near Appleton; Winnebago Co.; Calumet Co., and Fond du Lac Co (Jackson, 1961:391, 395). Michigan: Early records from Marquette Co. on the Upper Peninsula, and Mason, Oceana, Montcalm, Allegan, Eaton, Ingham, Kalamazoo, Calhoun, Jackson, and Berrien counties of lower Michigan (Burt, 1948:166). Illinois: Formerly in Cook Co., but rare (Cory, 1912:282). Indiana: Formerly in Porter, St. Joseph, Elkhart, and Steuben counties (Lyon, 1936).

Lynx rufus (Schreber). BOBCAT.

Lynx rufus rufus (Schreber).

Aesthetic attributes: A graceful cat. Feared and admired, and harmless to man.

Values: The fur is valued, and the flesh is edible. Often hunted as a game animal, bobcats in some states are bountied. Occasionally bobcats feed on farm animals, but rabbits, mice, birds (including game birds) and perhaps an occasional fawn are the animals usually eaten.

Status: Uncommon.

Distribution: Occurs throughout region east of Lake Michigan (Fig. 34).

Specimens examined: None. *Other records:* Michigan: Early records from numerous counties on Lower Peninsula (Burt, 1948:171). Indiana: Formerly in numerous northern counties (Lyon, 1936).

Remarks: Differs from *Lynx rufus superiorenensis* in having less inflated braincase, palate inclined anteriorly, and larger upper premolar and molar.

Lynx rufus superiorenensis Peterson and Downing.

Description, Aesthetic attributes, Values, and Satus: See account of *L. r. rufus*.

Distribution: West of Lake Michigan, but unknown on Washington Island and from several counties along the lake (Fig. 34).

Specimens examined: Wisconsin: Forest Co., no specific locality (1). *Other records:* Wisconsin: Numerous counties before 1900, numerous counties north of Fox River and including Brown, Calumet, and Fond du Lac counties after 1900 (Jackson, 1961:403). Michigan: Numerous counties on Upper Peninsula (Burt, 1948:171). Garden Island (visitant) (Phillips *et al.*, 1965). Illinois: Early records from Cook Co., assigned on dubious geographic grounds (Cory, 1912:293).

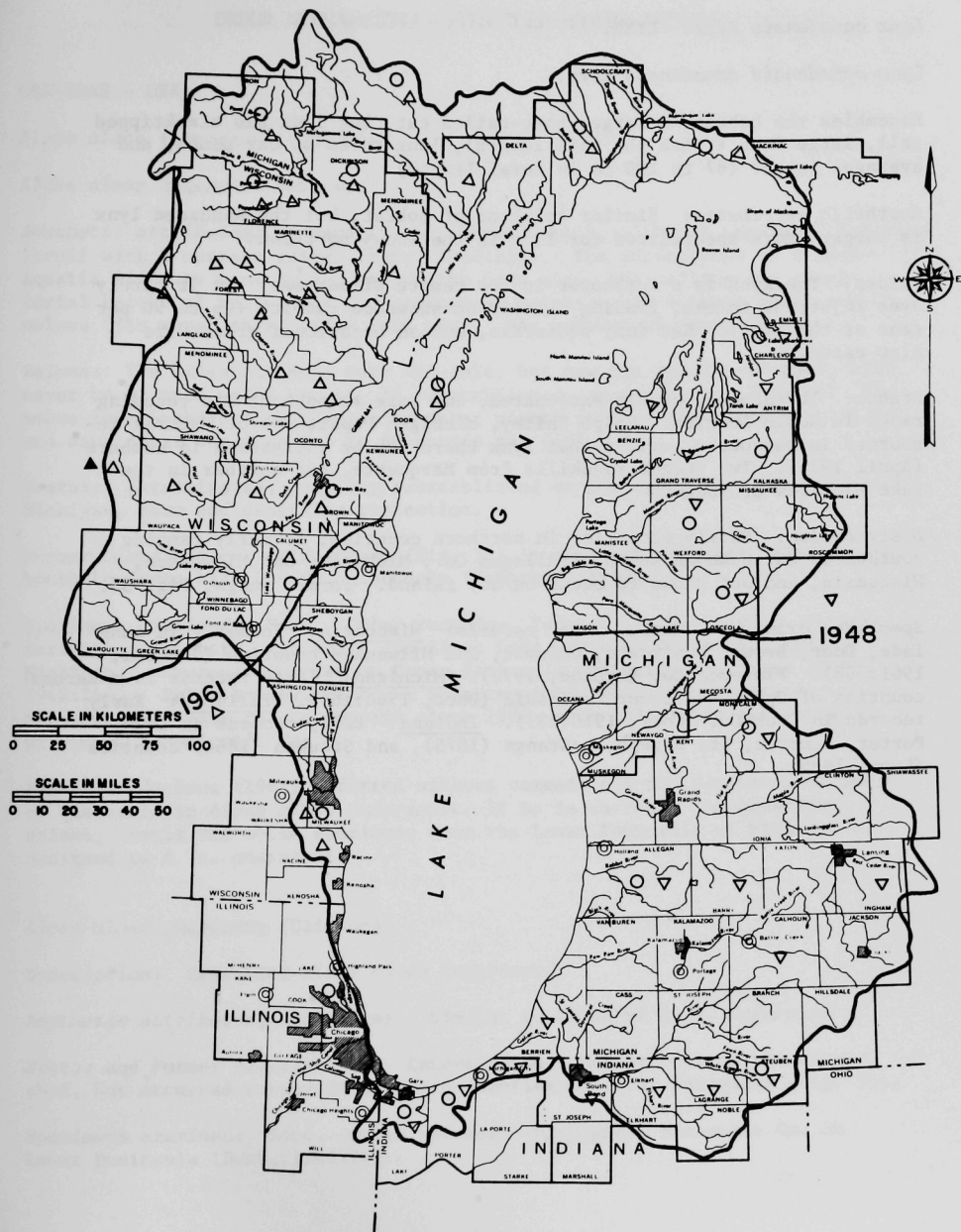


Fig. 34. Distribution of *Lynx canadensis* (former range circles), *L. rufus superioyrensis* (triangles) and *L. r. rufus* (inverted triangles). Recent distribution denoted by date-boundaries for *rufus*.

Lynx canadensis Kerr. LYNX.

Lynx canadensis canadensis Kerr.

Resembles the bobcat, a large short-tailed cat, but lynx has blacktipped tail, large feet (twice the tail length), long tufts on ear pinna, and averages larger (87 to 100 cm in total length).

Aesthetic attributes: Similar to those of bobcat, but the handsome lynx is larger, more specialized for life in the snowy northland.

Values: The lynx is a furbearer in the remote wilderness. It is hardly ever injurious to man, feeding chiefly on snowshoe rabbits (up to 90 per cent of the diet). Red fox, squirrels, and an occasional grouse are also eaten.

Status: Threatened, nearly extirpated, and rare throughout its receding range in North America. Ralph Bailey, Michigan Department of Natural Resources in Marquette, writes that lynx there may be increasing in numbers (April 1973). Two recent roadkills from Marquette, but neither in the Lake Michigan drainage.

Distribution: Rarely occurring in northern counties; formerly ranging southward, but unknown south of Allegan Co., Michigan, and Milwaukee, Wisconsin, and not known to occur on any island. Former range, Fig. 34.

Specimens examined: None. *Other records:* Wisconsin: Formerly in Langlade, Door, Brown, Manitowoc, Calumet, and Milwaukee counties (Jackson, 1961:398). Florence Co. (McCabe, 1972). Michigan: Early records in numerous counties of Upper and Lower Peninsula (Burt, 1948:169). Illinois: Early records in Cook Co. (Cory, 1912:287). Indiana: Early records in Lake, Porter, Laporte, St. Joseph, LaGrange (1875), and Steuben (1864) counties (Lyon, 1936).

ORDER ARTIODACTYLA--EVEN-TOED HOOFED ANIMALS

CERVIDAE - DEER

Alces alces (Linnaeus). MOOSE.

Alces alces andersoni Peterson.

Aesthetic attributes: A magnificent cervid, which, although ungainly, "carries itself with a certain grace" (Burt, 1948:259). The adaptations to a semi-aquatic life are remarkable, as are the huge size, the calling and territorial battle of bulls, and the ecological relationship between moose and wolves (its worst enemy aside from man). See account of *Canis lupus*.

Values: The hides and meat were valuable, but now the species probably will never be of much value except, if reestablished, as an aesthetic asset. The moose is a herbivore that feeds on water plants such as pond lilies, willows, and many other saplings (up to 60 pounds per day).

Status: Exterminated, possibly reestablished on the Upper Peninsula of Michigan, rare and deserving protection.

Former Distribution: Widespread (Fig. 35) in northern counties, ranging south to Green Lake County, Wisconsin (Schorger, 1957).

Specimens examined: None. **Other records:** Formerly in Wisconsin: Forest, Marinette, Waushara, Winnebago and Green Lake counties (Schorger, 1957). Michigan: Numerous counties on Upper Peninsula, reintroduced there (Burt, 1948:260). Ralph Bailey, Michigan Department of Natural Resources in Marquette provides recent records since 1970, near Shingleton and south of Seney, Schoolcraft Co.

Remarks: Jackson (1961) referred without comment all the specimens of moose of Wisconsin to *Alces alces andersoni*. If he is correct, the question arises, should the moose specimens from the Lower Peninsula of Michigan be assigned to *A. a. andersoni*.

Alces alces americana (Clinton).

Description: Resembles *Alces alces andersoni*.

Aesthetic attributes, and Values: Similar to those of *A. a. andersoni*.

Status and Former distribution: Exterminated. Hardly entered the watershed, but occurred rarely in northern counties of Lower Peninsula (Fig. 35).

Specimens examined: None. **Other records:** Michigan: Missaukee Co. on Lower Peninsula (Burt, 1948:26).

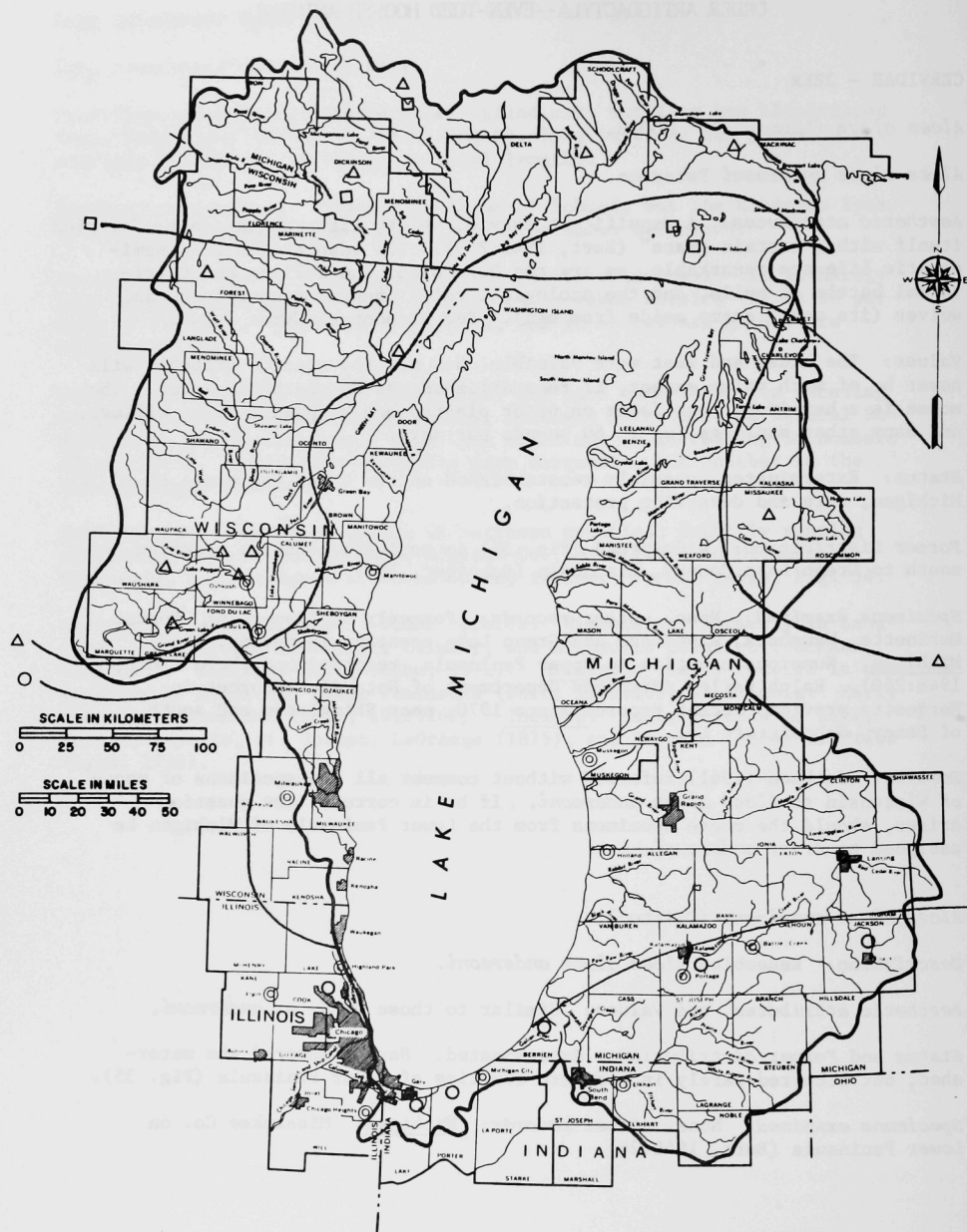


Fig. 35. Distribution of *Alces alces* (triangles), *Rangifer tarandus* (squares) and *Bison bison* (circles). See text.

Odocoileus virginianus (Zimmermann). WHITE-TAILED DEER. Also called Virginia deer.

Odocoileu virginianus borealis Miller.

Aesthetic attributes: The stately stag, graceful doe, and sprightly fawn are loved by all. Nevertheless, the deer, aside from its economical values and especially in regions where carnivores have been extirpated, is destructive to the natural environment.

Values: The hides are used for "doeskin" leather. The furred skins are used for rugs. The meat is valuable, nearly as much as beef, and many people in the region supplement beef with venison. The deer browses in winter on branches of trees and paws in the snow for saplings and grass. Many young trees are destroyed. Often the deer starve for lack of food, because their numbers are too high. Nevertheless, hunters want higher numbers of deer to increase the yield. The revenues expended by deer hunters on licenses, guns, and other hunting accessories and conveniences are a boon to the states. Deer often collide with cars causing much damage and some danger to human life. Finally, deer injure the farmer's crops, gardens, orchards, and pine plantations.

Status: Greatly decimated by lack of protection in early 1900's, but now abundant. A review on deer in Wisconsin was written by Dahlberg and Guettinger (1956).

Distribution: Occurs throughout the region in rural and semirural areas (Not mapped).

Specimens examined: None. **Other records:** Wisconsin: Numerous counties, but not occurring in industrial areas of the southeastern Wisconsin Lake Winnebago area, and lower Fox River Valley (Jackson 1961:416). Michigan: Formerly throughout watershed (including Beaver and North Manitou Islands), but now absent from farming districts in southern half of lower Michigan (Burt, 1948:256). Introduced onto Beaver Island in 1927-1928 (Ozoga and Phillips, 1964) and Garden Island (Phillips *et al.*, 1965). Illinois: Formerly in Cook Co. (Cory, 1912:60). Indiana: Lake, Porter, Laporte, St. Joseph, Elkhart, LaGrange, Steuben, and Noble counties (Lyon, 1936).

Cervus canadensis Erxleben. WAPITI, AMERICAN ELK.

Cervus canadensis canadensis Erxleben.

Aesthetic attributes: Majestic is the word for the stately elk.

Values: The hides and meat of the elk are valuable, and where abundant (such as in the Rocky Mountains) elk are popular game mammals.

Status: Extinct in Michigan since about 1870, in Wisconsin before 1875, probably 1868 (Burt, 1948, Schorger, 1954). Several reintroductions of *Cervus canadensis nelsoni* from Jackson Hole, Wyoming, have failed.

Former distribution: Lower Peninsula of Michigan and generally throughout the watershed lying south and west of Lake Michigan, but absent from all islands, the Door Peninsula, and northern counties of Wisconsin and all of upper Michigan (Not mapped).

Specimens examined: None. *Other records:* Wisconsin: Numerous southern counties, and in Brown, Outagamie, and Waupaca counties north of Fox River (Schorger, 1954). Michigan: Numerous counties on Lower Peninsula (Burt, 1948:253-254). Illinois: Cook Co. (Cory, 1912:67). Indiana: Lake, Porter, Laporte, and St. Joseph counties (Lyon, 1936).

Rangifer tarandus (Linnaeus). WOODLAND CARIBOU. Also called reindeer.

Rangifer tarandus sylvestris (Richardson).

Description: Mostly resembles moose but lighter in weight (200 to 300 pounds); tail short (as in elk), antlers semipalmate and found on both sexes, flattened brow tines extend over the eyes; head and neck whitish, back brown, rump whitish (fawns hardly spotted).

Aesthetic attributes: This cervid brings the far north to mind. The caribou, of mesic forests, bogs and swamps, was an interesting invader from the boreal fauna.

Values: Meat, leather, and sport.

Status: Exterminated about 1910 or earlier.

Distribution: Known rarely in lower Michigan, on two islands, and in upper Michigan (Fig. 35).

Specimens examined: None. *Other records:* Michigan: Marquette and Dickinson counties, Upper Peninsula, Beaver and High islands (Burt, 1948:263).

BOVIDAE - CATTLE

Bison bison (Linnaeus). BISON. Also called buffalo.

Bison bison bison (Linnaeus).

Aesthetic attributes: This great and powerful herbivore grazed in countless numbers on the prairies of interior North America and was nearly exterminated by wasteful slaughter (Long, 1965). Kept penned, bison are raised locally in many parks, game farms and zoos in the region. A part of American history, the huge bison (up to 2,000 pounds in weight) provided meat to pioneers, and aided development of the West by white man, and in earlier days provided food and leather to numerous native American tribes. Wolves preyed on sickly and aged bison.

Values: Meat, leather, and sport.

Status: Exterminated about 1832.

Former distribution: Southern counties only (Fig. 35).

Specimens examined: None. *Other records:* Michigan: Early records from Jackson, Kalamazoo, and Berrien counties, southern parts of Lower Peninsula (Burt, 1948:265). Illinois: Cook Co. (Cory, 1912:88). Indiana: Lake, Porter, and St. Joseph counties (Lyon, 1936).

HABITAT PREFERENCE AND HOME RANGE

Curtis (1959) has written a classic study of plant communities of Wisconsin, and Stearns and Kobriger (in press, this series of Argonne reports) extended this carefully descriptive study to the entire watershed of Lake Michigan. The analysis of the occurrence of mammals in these plant communities facilitates understanding of certain ecological relationships. Some mammals may not survive unless we speedily attempt to study and protect them. Extirpated and abundant mammals are not included. The home ranges of selected mammals recorded here are cited from several of the works listed in the references, but especially in the work of Jackson (1961).

Communities: Lying generally along the Wisconsin moraine is an ecotone separating communities to some extent into northern (N) and southern (S) groupings.

N1. Cat-tail or Reed Marsh	S1. Cat-tail or Reed Marsh
N2. Northern Sedge Meadow	S2. Southern Sedge Meadow
N3. Alder Swamp	S3. Shrub Carr (willow, dogwood)
N4. Northern Lowland (tamarack) swamp (also black spruce)	S4. Southern Lowland Forest and Relic Bogs (maples)
N5. Northern Wet Mesic Forest (white cedar)	S5. Southern Wet Mesic Forest (American elm)
N6. Northern Mesic Forest (sugar maple)	S6. Southern Mesic Forest (maples)
N7. Dry Mesic Forest (white pine)	S7. Southern Dry Mesic Forest (red oak)
N8. Dry Forest (jack pine, red pine)	S8. Southern Dry Forest (black oak)
N9. Jack Pine Barrens (also numerous grasses)	S9. Xeric Dry (Hill) Prairie (sunflowers, bluestems)
N10. Birch-Aspen Forest	S10. Mesic Prairie (legumes, luxuriant grassland)
N11. Boreal (spruce-fir) Forest	S11. Lowland (wet) Prairie (slough grass, forbs, grasses)
	S12. Oak Openings (savanna) (white oak)

Ecological distribution: Threatened or uncommon mammals of the Lake Michigan watershed are listed (Table 1) to indicate habitat preference by major plant communities; additional comments on known ecological requirements are self-explanatory. Nearly twice as many of these species occur in the northern communities as in southern ones. Most northern communities are well represented by the mammals, except Dry Mesic Forest and Dry Forest, the most depauperate are the Jack Pine Barrens. Birch-Aspen Forest is not quite so well represented as the remaining northern communities. The southern communities are not strongly represented, except Oak Savanna, followed by Mesic and Dry Mesic Forest.

Using average-resemblance coefficients to indicate faunal resemblance (of mammals) Long (1970) showed that in central Wisconsin the prairie resembles the Dry Forest edge (Oak Savanna) most and the Jack Pine Barrens next. These bleak, dry communities are not greatly dissimilar in terms

Table 1. Relation of Selected Uncommon or Threatened
Animals to Plant Communities, with Additional
Comments on their Ecology and Home Range

Species	Plant Community	Comments	Home Range
<i>Scalopus aquaticus</i>	S9-11, ?S12	-	<1 acre to >2 acres
<i>Condylura cristata</i>	N3-N6, N10, N11	Up to 30/acre; 10-12/acre are rare	-
<i>Sorex palustris</i>	N1-N6, N10, N11 (near water)	-	-
<i>Sorex arcticus</i>	N1-N4 (near water)	-	146-ft radius (Buckner)
<i>Microsorex hoyi</i>	N1-N11	Wet and dry habitats, disturbance, water nearby, seldom abundant	-
<i>Microsorex thompsoni</i>	S1-S8, S12	Wet and dry habitats, water nearby, endangered by loss of last remaining habitats. Never abundant	-
<i>Cryptotis parva</i>	S9-S11, ?S12	Very rare	Approx. 1000 sq yd
<i>Myotis keenii</i>	-	Caves required, hibernacula	-
<i>Lasionycteris noctivagans</i>	-	Feeds on Trichoptera and beetles, prefers deciduous forests	-
<i>Nycticeius humeralis</i>	-	Feeds on moths, beetles, flies, planthoppers, and bugs	-
<i>Lasiurus cinereus</i>	N6-N8	Feeds on moths, flies, Chrysomelidae	-

Table 1. Continued

Species	Plant Community	Comments	Home Range
<i>Lepus americanus</i>	N1-N5, N11, ?N6	-	600-800 ft radius
<i>Lepus townsendii</i>	N1, N2, S10, S11, S1, S2	Requires open country	-
<i>Tamias striatus</i> <i>doorsiensis</i>	-	Restricted geographic range, but ubiquitous within it	200-ft radius, or 1 or 2 acres, (up to 20/acre)
<i>Eutamias minimus</i>	N1-N6, N10-N11	Range retreating Northward	<1 acre, or 40-50-ft radius
<i>Marmota monax</i>	S12, N6-N8, S6-S9	-	200-300-ft radius up to 800 ft
<i>Spermophilus</i> <i>franklinii</i>	N1, N2, S1, S2, S11	-	150-200-ft radius
<i>Tamiasciurus</i> <i>hudsonicus</i>	N4-N11	-	500-600-ft radius, up to 2000 ft (food short)
<i>Glaucomys sabrinus</i>	N5-N11	Woodpecker cavities, hollow trees	-
<i>Castor canadensis</i>	N1-N6, N10, N11, S1-S6, S11	Requires water	Up to 300-ft radius (may disperse up to 30 miles)
<i>Peromyscus</i> <i>maniculatus</i> <i>gracilis</i>	N3-N8, N10, N11	-	500-1500 sq yd, or 1.39-5.64 acres
<i>Microtus</i> <i>ochrogaster</i>	S9-S12	-	1/5 - 1/10 acre
<i>Synaptomys cooperi</i>	N6-N8, N11, S4-S8, S12	-	200-ft radius, or 1 acre

Table 1. Continued

Species	Plant Community	Comments	Home Range
<i>Pitymys pinetorum</i>	N6, S6, S7	-	Approx. 100-ft radius
<i>Napeozapus insignis</i>	N1-N6, N10, N11	-	1 1/2 acres
<i>Erethizon dorsatum</i>	N1-N8, N10, N11, S1-S8, S12 (requires trees)	-	-
<i>Canis latrans</i>	N1-N11, S1-S12	-	11 sq mi or less, linear movement 8-10 mi
<i>Canis lupus</i>	N1-N11? (formerly S1-S12)	-	150-250 mi
<i>Urocyon cinereoargenteus</i>	N4-N9, S4-S8, S12	-	1/4-1/2-mi radius
<i>Ursus americanus</i>	N1-N11 (formerly S1-S8, S12)	-	500-600 sq mi, disperses 10, up to 80 mi
<i>Mustela frenata</i>	Usually in N5-N8, S5-S8, S12 (ubiquitous)	-	30-40 acres or less
<i>Mustela erminea</i>	N1-N5, ?N11, S1-S3, S11	-	30-40 acres or less
<i>Mustela nivalis</i>	N1-N2, S10-S11	? Wet communities in watershed, rare	<2 acres
<i>Mustela vison</i>	Ubiquitous (requires water)	-	30-80 acres, wandering up to 18 mi
<i>Martes pennanti</i>	-	Reintroduced, requires extensive wilderness	4-7 1/2-mi radius, wanders 40-100 mi
<i>Taxidea taxus</i>	N2, N9, S2, S9-S12	-	850 hectares (one badger per sq mi)

Table 1. Continued

<i>Species</i>	<i>Plant Community</i>	<i>Comments</i>	<i>Home Range</i>
<i>Lutra canadensis</i>	N1-N6, N10, N11 (requires water)	Formerly in southern communities	For females 2 mi or less; males 20-30 mi, wanders 100 mi
<i>Lynx rufus</i>	Ubiquitous	-	Wanders 50-150 mi
<i>Lynx canadensis</i>	N1-N11	Confined to northern extensive forests	- (Great movements likely)

of these coefficients, the latter replacing the former in northern latitudes (Stearns and Kobriger, in press). Furthermore, the mesic forest (coniferous and hardwood) was shown to resemble the swamp. None of the communities listed is destitute of mammals; three of them occur in Shrub Carr (a plant community which may contain numerous "abundant" mammals but which normally is small in size). Bats were omitted in the analysis of these communities and from the earlier faunal resemblance study.

ZOOGEOGRAPHY OF RECENT MAMMALS

Some Recent mammals, particularly those hunted and trapped intensively for fur or food, have been extirpated by man throughout the entire watershed (bison, elk, caribou, moose, mountain lion, wolverine, fisher, marten) and others nearly extirpated (lynx, wolf). Of these, the moose, fisher, marten, and the elk have been reintroduced, although the elk and marten have not become reestablished. Some mammals have been threatened with extermination in the past, but have prospered under wise management and improved habitat (white-tailed deer, bear, and beaver). Some species today, especially the small, obscure ones, are threatened by loss of habitat and/or lack of protection (*Microsorex thompsoni*, *Cryptotis*, *Tamiasciurus*, *Eutamias*, *Ursus*, *Erithizon*, bats). Some piscivorous and aquatic forms are endangered by wide application of fish toxicants and by industrial pollution (muskrat, water shrews, mink, otter).

Since the Valdres glacial maximum and subsequent soil formation and establishment of a stable shoreline, the watershed has been occupied by diverse mammals. The early arrivals were apparently boreal (*Peromyscus maniculatus gracilis*, *Vulpes vulpes*, *Rangifer*, *Alces*, and others). Later southern invaders have been rapidly gaining territory, especially since white man settled the region and cut away the great forests (for example, opossum, fox squirrel, cottontail, white-footed and prairie deer mice, thirteen-lined ground squirrel, and prairie vole).

Both animals and plants have segregated themselves generally on the basis of their relative adaptation to latitude and local climatic and vegetational patterns (see Curtis, 1959; Dice, 1938). Thus, there are two somewhat distinctive assemblages of mammals: Boreal (or northern) and southern (deciduous forest species and generally western prairie mammals). *Clethrionomys*, *Martes*, *Tamiasciurus*, *Eutamias*, *Glaucomys sabrinus*, and *Peromyscus maniculatus gracilis*, as well as the large moose and caribou are boreal examples. *Pitymys*, *Cryptotis*, *Sylvilagus*, *Spermophilus franklinii*, *Peromyscus leucopus*, *P. maniculatus bairdii*, *Didelphis*, and *Bison* were southern invaders. None of the boreal forms has dispersed southward recently (DeVos, 1964).

Ordinarily the species select habitats because of factors such as food (*Peromyscus*, Getz, 1961), cover (Getz, 1961), and water availability (Buckner, 1966; Long, 1972). Occasionally species compete, for food and habitat, such as *Peromyscus leucopus* and *P. maniculatus gracilis* (Long, 1970); *Sorex arcticus* and *S. cinereus* (Buckner, 1966); *Glaucomys volans* and *G. sabrinus* (Muul, 1968); or *S. cinereus* and perhaps *Microsorex* (Long, 1972b). *Tamias* and *Eutamias* and the lynx and bobcat may compete with one another. Most of these examples of competition result from confrontation of boreal and closely related southern taxa.

Man has introduced some species, mostly injurious, as introductions of new species often are. These include *Rattus*, *Mus*, and *Lepus townsendii*. By man's actions (cutting the forests) certain species have become introduced into new areas (prairie deer mouse, tree squirrels, cottontail, probably *Eptesicus*). Intentional introductions have been made on some islands.

Only a few endemic or relict geographic races have been identified; these (*Tamias striatus doorsiensis*, *T. s. peninsulae*, *Microsorex thompsoni*,

perhaps others) appear to have evolved in local post-Pleistocene refugia, or at least to have been isolated by river drainages leading south from Lake Michigan and perhaps, in *Tamias*, by fluctuating lake levels (Hough, 1963). The highland of the Door Peninsula apparently was a cul-de-sac within a once glaciated and often nearly submerged region. Here *T. s. doorsiensis* differentiated.

Numerous post-Pleistocene species were isolated as separate populations east and west of the lake (by dry forest and prairie conditions and the former lake outlet at the south end, and by the still formidable Straits of Macinac at the north end). Species and subspecies east-west pairs include *Maxmota monax monax* and *M. m. rufescens*, *Sorex cinereus cinereus* and *S. c. leseurii*, *Microsorex hoyi* and *M. thompsoni* as well as others.

The margin or low divide bounding the watershed is, surprisingly, an effective barrier to some species. Some have dispersed along the margin but hardly into the drainage basin itself. This may show that the watershed was unsuitable and perhaps remains so to some mammals. For example, *Geomys bursarius* ranges closely to the divide in Indiana. Numerous insectivores, such as *Scalopus aquaticus* and *Sorex arcticus*, approach the drainage basin from the south, west, and north in Wisconsin. *Sorex palustris*, an obscure aquatic form, manages to penetrate into the basin at least along one major stream in northern Wisconsin. In Michigan, species including *Sorex cinereus*, *Microsorex thompsoni*, *Mustela erminea*, *Glaucomys volans*, *Pitymys pinetorum*, *Napeozapus insignis*, and even *Alces alces* hardly invade the watershed on the lower peninsula.

All these ranges comprise a pattern, which clearly indicates that the watershed has become available only recently to the besieging species. Along the lake shore fluctuating water levels may have restricted some species. The persistently boreal climate that lasted as long as the glaciers, and the established boreal forests that lasted and remain in many places even today exerted a profound influence in establishing a boreal fauna.

Lake Michigan has changed remarkably since the Valdres maximum (Hough, 1963), and it is not surprising that few species occur on the isolated islands which appeared in the post-Pleistocene time (perhaps 8,000 years ago). *Lepus americanus*, *Peromyscus maniculatus gracilis*, *Vulpes vulpes*, and the caribou are species (all boreal) that became well established on numerous islands, and of course some bats have crossed the formidable water barrier to the larger islands.

Ozoga and Phillips (1964) have discussed how mammals may have colonized Beaver Island: e.g. temporary land bridge; possible rafting; bats by air; *Lepus*, *Rangifer*, *Lynx rufus*, *Vulpes* over the frozen lake; and many with the assistance of man. In the author's opinion, they rely too much on the last, in the case of *Peromyscus maniculatus gracilis* and perhaps *Clethrionomys* and *Sorex*. These kinds may have been long established. The fauna of Beaver Island resembles that of the Upper Peninsula.

The isolation of the islands is enhanced by the apparent inhospitable nature of the entire watershed to some animals. *Sorex cinereus* and *Blarina* are the only shrews that occur widely in the northern part of the drainage basin, and none of the others is known from any island.

Another important barrier is the Straits of Mackinac, which prevents some species from crossing from the Lower to the Upper Peninsula of Michigan, or vice versa. *Sorex arcticus* (which seems to be prohibited from entering the watershed at various points) as well as boreal *Eutamias* have not crossed this barrier. *Sorex cinereus cinereus*, *Sorex palustris*, *Clethrionomys gapperi*, and *Peromyscus maniculatus gracilis* have recently crossed or have been limited by ecological factors (such as drier habitats) from dispersing very far into lower Michigan.

Another effective barrier, surprisingly, is the Fox River Valley extending from Lake Winnebago to Green Bay. Some subspecies and species cannot cross it, and some that have crossed did so recently and hardly have dispersed beyond it (*Spermophilus tridecemlineatus*, *Peromyscus maniculatus bairdii*, *P. leucopus*, *Glaucomys volans*). Whether this pattern results from the biomes meeting in the area, or whether lake levels and lake outlets (with the boreal influence of glaciation) effected this pattern is unknown.

The southern shore of the lake, in Illinois and Indiana, is another area where numerous taxa find their geographic limits. For one thing, this area is south of the border of the northern forests and is approached by prairies. For another, the lake has served to divide southern invaders of Michigan and Wisconsin, with a former glacier or deep water barring gene flow at the north end. The circumlacunar distributions probably became disjunct on either side of the lake in warm periods (climatic optimum) by the retreat northward of boreal habitats, and by fractionation in cooler periods of glacial advance. Lake Michigan drained to the Mississippi River southward through the Chicago outlet, establishing an important barrier at the south end in post-Wisconsin time.

Martin's (1965:296-7) reconstruction of lake history reveals that the Chicago outlet for the Illinois River was the primary and eventually the only drainage to the Mississippi River. But the St. Croix, Wisconsin, Wolf (leading off the glacier), Rock and Illinois Rivers all lay across the routes of northward invasion by southern forms. The Wabash drainage temporarily isolated lower Michigan. Probably only boreal forms could colonize the upper reaches of these glacier-fed streams. After the glacier receded, waters flowed toward Lake Michigan, and the nearby boreal species invaded the now accessible watershed.

Not until after the Lake Michigan glacier receded did the Straits of Mackinac appear, and the waters of the lake ceased to flow south through the Chicago outlet. Some boreal forms eventually crossed the Straits into lower Michigan. Many northern species were replaced on either side of the lake by southern invaders.

There is a faunal hiatus of some significance in the central part of lower Michigan, possibly owing somewhat to man's activities. Dice (1938) describes the border of the Canadian biotic province as extending across this area. Thus, the northeastern hardwoods forests are separated from drier forests of oak and hickory along this boundary. *Sorex cinereus cinereus* and *S. c. leseurii* seem separated by this "barrier". The coyote seems to have emigrated from the south and is now moving in from the Straits of Mackinac. Numerous boreal and southern species have not dispersed through this area.

To sum up, the Lake Michigan watershed seems to be a new, "uncovered" environment with a few endemic or relict populations, and many boreal and southern invaders. Their routes of invasion are often apparent, and important barriers of several kinds can be recognized. Boreal forms seem to have occupied the region earlier than did the southern prairie and deciduous woodland taxa; the latter have gained considerable territory, especially since the advent of white man. There are some species that approach the watershed at several points but fail to immigrate extensively into the region. Sixty-eight species occur or occurred in the watershed (not including *Sorex fumeus*), including the introduced *Rattus*, *Mus*, and *Lepus townsendii*. The deer mice are considered as a single species although the subspecies act in this watershed as two species. All species and subspecies (except *S. fumeus*) total 84 taxa.

The bats *Myotis sodalis* and *Pipistrellus subflavus* may eventually be taken in the watershed.

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